COTS JOURNAL®

Tech Focus: PXI/VXI Boards

VME for the Next 25 Years–Part II:

INDUSTRY EXECS LOOK FORWARD

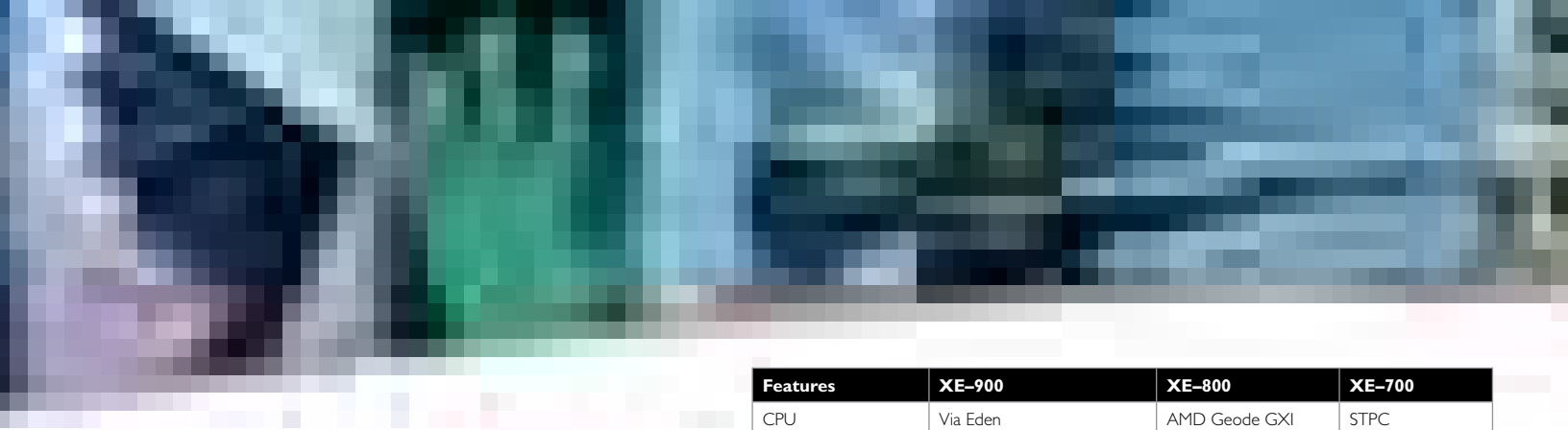
PLUS:

PC/104 Blends Fast Pace, Small Space

Top Safety-Critical SW Trends: Security and Reuse

Volume 8 Number 4 April 2006 www.cotsjournalonline.com

An RTC Group Publication



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Clock speed	400 MHz; 733 MHz; 1.0 GHz	300 MHz	133 MHz
BIOS	General Software	Phoenix	Phoneix
DRAM support	to 256 MB	to 256 MB	32/64 MB
Compact/Flash	Type I or II	Type I or II	Type I or II
COM 1	RS–232	RS–232/422/485	RS–232
COM 2	RS–232	RS–232/422/485	RS–232/422/485
COM 3	RS–232	NA	RS–422/485
COM 4	RS–232	NA	RS–232
COM 5	RS–232/422/485	NA	NA
COM 6	RS–422/485/TTL	NA	NA
LPT1	0	0	1
EIDE	2	2	1
USB	2	6	2
CRT	1600 x 1200	1280 x 1024	1280 x 1024
Flat panel	LVDS	yes	yes
Digital I/O	24–bit prog.	48–bit prog.	24–bit prog.
Ethernet	10/100 Base–T	Dual 10/100 Base–T	10/100 Base–T
Expansion	PC/104 & *Plus*	PC/104 & *Plus*	PC/104
Power	3.6A operating	1.6A max.	1.6A max
Temp. range	–40° to 70/85° C	–40° to 80° C	–40° to 80/85° C
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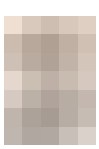

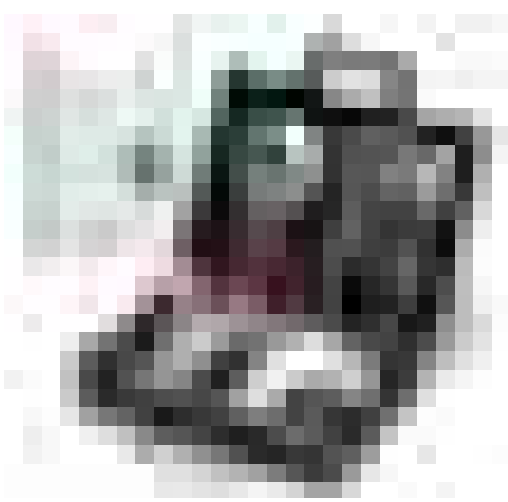

Typical Linux kit includes:

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- *X–Windows support*
- *Example applications and source code*
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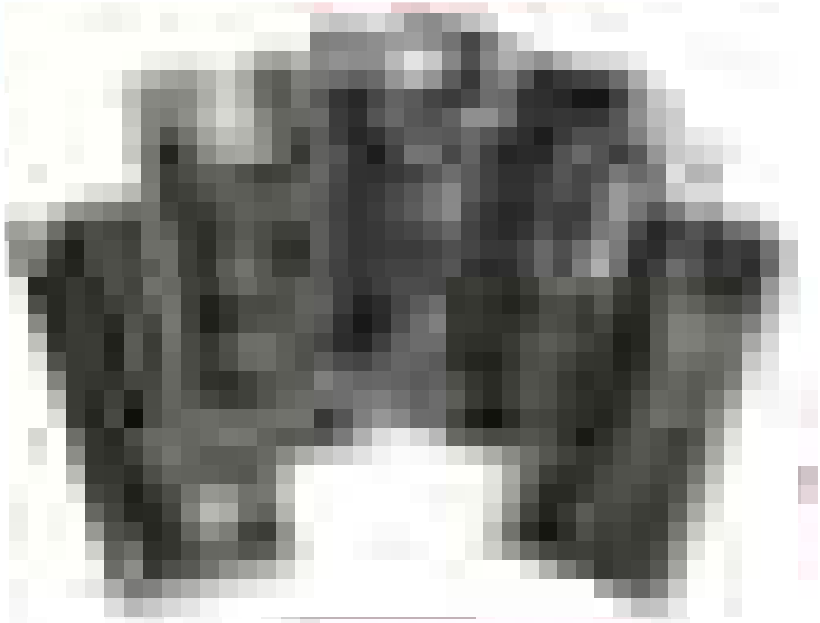

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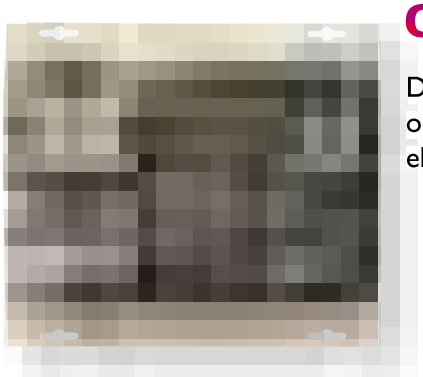

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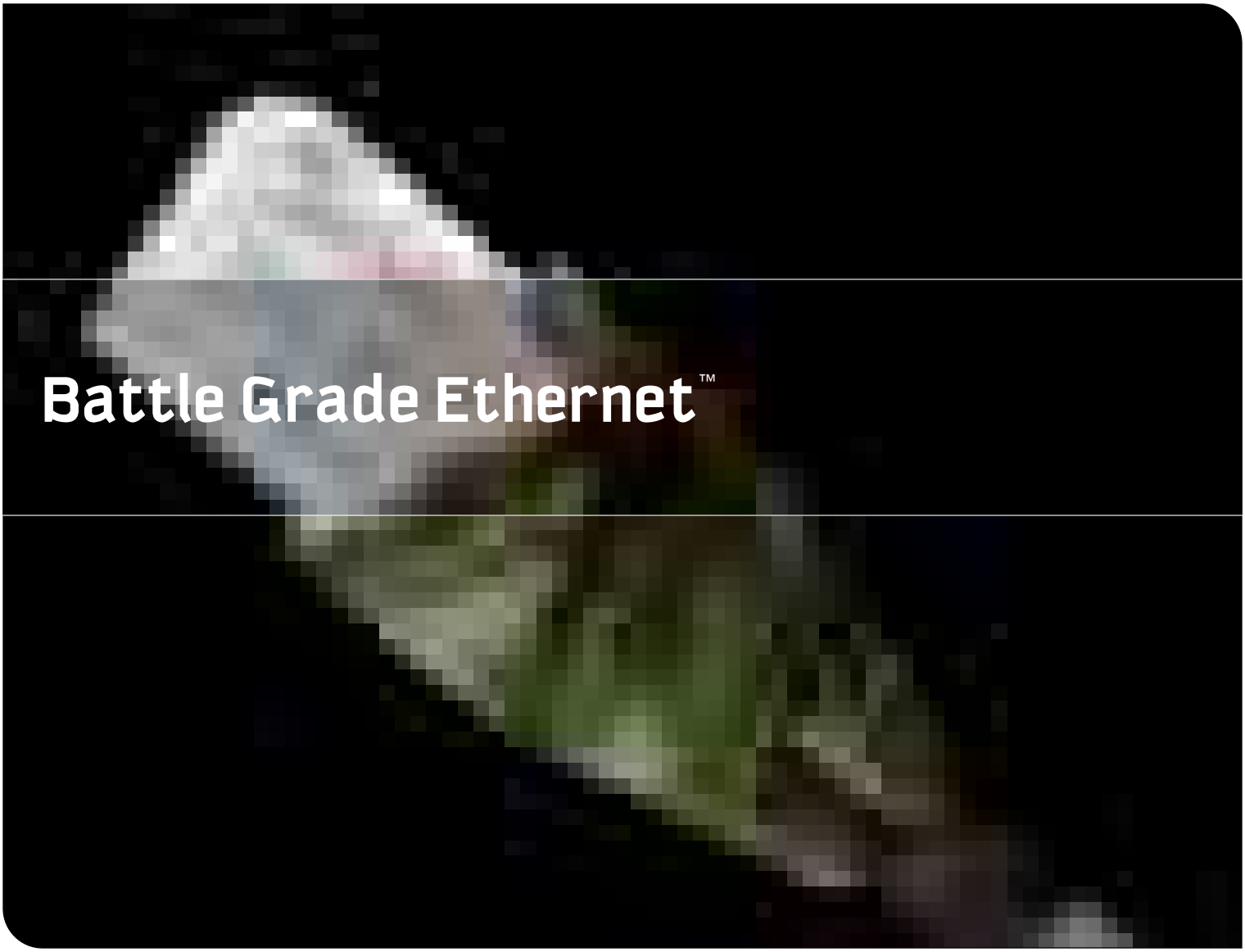

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COTS JOURNAL

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Main Feature

PC/104 in the Military

Tech Recon

VME for the Next 25 Years: Part II

System Development & Test

Safety-Critical Systems & Software

Special Section

MEECC Show Preview

Technology Focus

PXI/VXI Boards

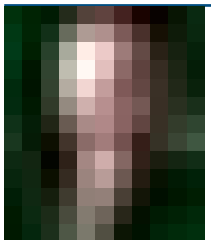
COTS (kots), *n.* **1.** Commercial off-the-shelf. Terminology popularized in 1994 within U.S. DoD by SECDEF Wm. Perry's "Perry Memo" that changed military industry purchasing and design guidelines, making Mil-Specs acceptable only by waiver. COTS is generally defined for technology, goods and services as: a) using commercial business practices and specifications, b) not developed under government funding, c) offered for sale to the general market, d) still must meet the program ORD. **2.** Commercial business practices include the accepted practice of customer-paid minor modification to standard COTS products to meet the customer's unique requirements.

——**Ant.** When applied to the procurement of electronics for the U.S. Military, COTS is a procurement philosophy and does not imply commercial, office environment or any other durability grade. *E.g., rad-hard components designed and offered for sale to the general market are COTS if they were developed by the company and not under government funding.*

Cover Story ..... Page 30

Still the backbone of the U.S. military's heavy armor force, the Abrams tank is expected to remain in use for another 35 years or more before being replaced. The newer digital Turret Network Box (TNB) and Hull Network Box (HNB) units aboard M1A1 Abrams tanks have a set of unpopulated VME card slots to allow for future electronic upgrades. Shown here, an M1A1 Abrams tank heads out on a mission in Iraq in 2004. Tank and crew were assigned to Bravo Troop, 1st Battalion, 4th Cavalry Regiment, 1st Infantry Division.

Courtesy: DoD photo by Staff Sgt. Shane A. Cuomo, U.S. Air Force



Publisher's Notebook

Last month I mentioned why the *COTS Journal* editorial team attends industry conferences: to stay on top of the market and the technology that we cover. MILCOM, AUSA, I/ITSEC are at one end of the spectrum of conferences that we follow, and ESC and MEECC are at the other. In February we were at AUSA, this month we're going to ESC in San Jose, and next month we're going to MEECC.

The RTC Group has two sister publications to *COTS Journal*—*RTC* and *PKG* magazines. Our combined editorial staff, if you include me, has over 150 years experience in the embedded electronics industry, and 100 of those years creating editorial. We capitalize on all that experience, along with our relationships with people in the industry, to each year produce a very concise Market Wrap-up and Forecast.

154 Years and Still Going Strong

At ESC we're meeting with about two-dozen companies to exchange information regarding the embedded marketplace—information that assists us in focusing our publications and enables our industry to plan for the changes and the future. For your benefit, let's see if I can boil down for you here a very basic summary of what our Wrap-up and Forecast provides.

The first step is to define what we are including when we say "Mid- to High-End Embedded Computer Market." That means mid- to high-end embedded computers; bus-based, stand-alone SBCs, modules, boards, boxes and software; standard and non-standard-based modules, boards, boxes and systems made for embedded applications; and parallel backplanes, serial interconnects and switched fabrics. I know this may seem a little confusing, but it's important to have this stake in the ground before throwing around numbers or comments about this market.

I don't have space in this column to put in graphs and charts from the report, but here's some numbers: In 2005 this market shipped roughly $6.7 billion, this year we will ship approximately $7.5 billion, and by 2009 we should hit $12 billion. All three major sectors of this market—military, communications and commercial/industrial—are going to experience growth, but the one that interests us the most is the military sector.

The military market, including captive (gray) market and the merchant market, shipped roughly $2.5 billion in 2005. The annual growth rate this year and next should be around 10% with as much as 15% in '08 and '09, resulting in over $4 billion in shipments by the end of the decade. This is while the annual overall military budget growth will probably hover only in the low single digits. Emphasis by the DoD and Congress may shift from one program to another and back again throughout this period, but the electronic content of every program including upgrades and retrofits will continue to increase.

This sounds like a pretty rosy picture of the near future. Well, there's always someone that has to raise some issues that could put a little sand into the wheels of progress. We have two looming issues that can cause distress in this market: government cash flow and RoHS. Between Afghanistan, Iraq and Katrina, we could be in the midst of a cash flow problem. The priority has to be the troops in the field and everything else is secondary. There have been rumblings that non-critical items are being stretched out. Non-critical Military travel is being curtailed. And all you ever hear from the areas devastated by Katrina is that the government promised them money, but no one has seen anything significant. As we all know, in the past the government just started the printing presses to resolve cash flow problems and the result was always inflation. Maybe this time we learned and we're going to avoid that pitfall. If these rumblings are just a hiccup, good. But if they are more serious then we may have some problems.

As for RoHS, it's being ignored by the military—the communications industry also—because the military is under the false impression that it has no effect on them. Like the COTS initiative in 1994, RoHS is a component issue—nothing more, nothing less. And it's not passive components. It's microprocessors and sophisticated ICs. If you can only get no-lead parts, it does have an effect on you, especially if you are looking at long life cycles and repair rather than throw away modules and boards. The saving grace here may be that we still have time to come up with a plan before critical parts are no longer available or in storage.

Our Wrap-up and Forecast also shows that the steady growth experienced the last two years in the Commercial/Industrial and Communications sectors will continue. But they too have caveats and potential sand in their wheels of progress. I guess that's what makes the embedded market so interesting and has kept our team here for more than 150 years. ▮▮

Pete Yeatman, Publisher
COTS Journal

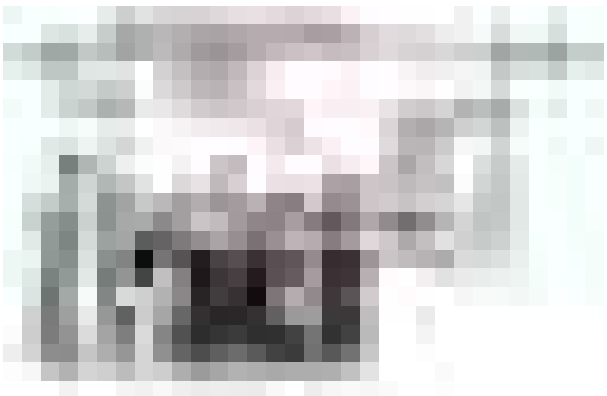
Design to Deployment with One Graphical Environment

Design with LabVIEW

Interactive algorithm design tools

Native simulation capabilities

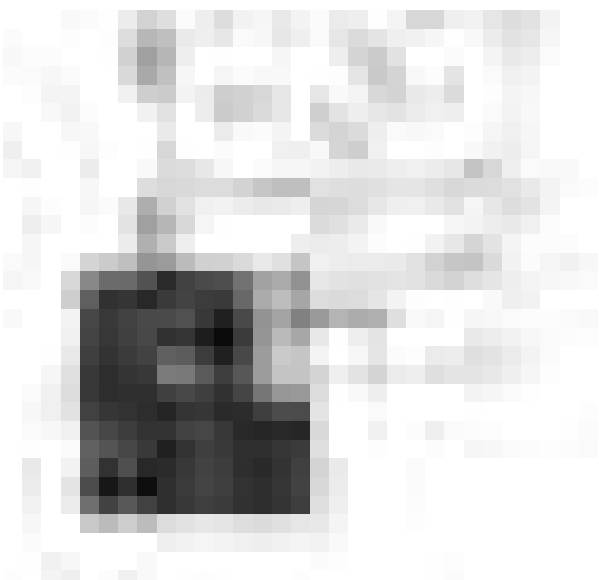
Built-in analysis and I/O



Prototype with LabVIEW

Reconfigurable FPGA I/O

COTS prototyping platform



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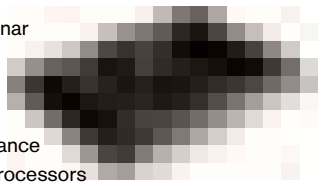
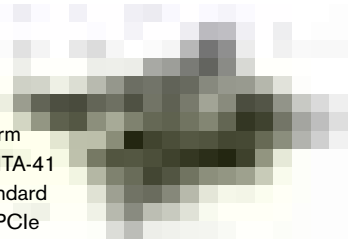
CHAMP-AV IV



Designed for radar, sonar and signal intelligence applications, the CHAMP-AV IV combines the performance of four 7447A/7448 processors up to 1.25GHz, with a non-blocking PCI architecture and onboard Gigabit Ethernet switch.

www.cwcembedded.com/dsp4

CHAMP-FX



The CHAMP-FX is an FPGA computing platform supporting the VITA-41 switch fabric standard with options for PCIe and Serial RapidIO. This 6U VME compatible card features two Xilinx Virtex-II Pro platform FPGAs.

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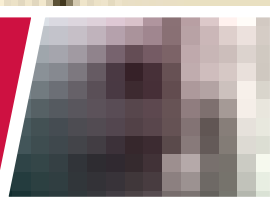

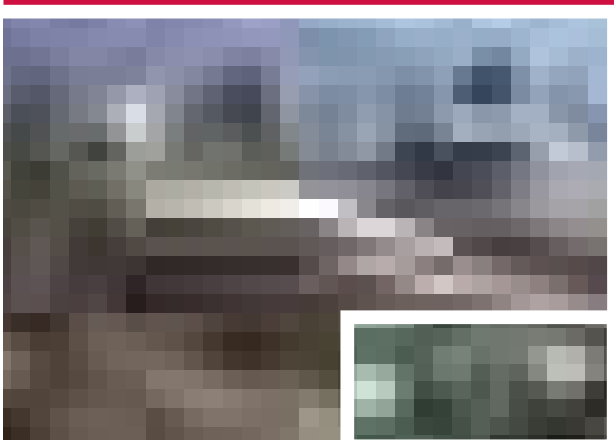

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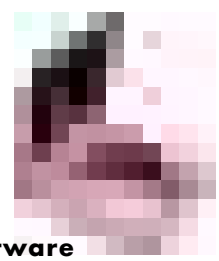

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Images courtesy of airforce.mil and navy.mil.

The Inside Track

Wind River's Development Environment Selected for FCS Program

The U.S. Army's Future Combat System (FCS) program will standardize on Wind River's Workbench as the foundation of the FCS Software Development Environment for its software development activities. Boeing, as Lead Systems Integrator (LSI) for FCS, chose to standardize on a single development environment for FCS software development. According to Wind River, Boeing selected Workbench based on its ability to operate across multiple development sites, hosts, operating systems and companies developing for the FCS program. The FCS is the central effort for the Army's transformation plan aimed at increasing the Army's agility, improving its capability to go anywhere and overcome any adversary. Referred to as a "system of systems," the FCS program and its constituent parts—are viewed as systems in themselves—including the 18 platforms, the network itself, and even the individual soldier. The 18 platforms (Figure 1) are comprised of a variety of manned and unmanned ground vehicles and UAVs. More than 2,000 developers in various development sites across the United States have teamed up to developed software for FCS.

Figure 1
The Non-Line-Of-Site Mortar (NLOS-M) vehicle, as depicted in this artist's rendering, is one of the 18 combat systems that comprise the Army's Future Combat Systems. (U.S. Army image.)

This project was competitively bid against by multiple companies to provide the FCS program with a common development environment. Wind River Workbench will be applied across the program to support the heterogeneous platforms that host the various applications. Workbench will be used to develop the system-of-systems common operating environment (SoSCOE), as well as other FCS applications and hardware projects, including battle command (BC) software, tactical and strategic communications, and intelligence, reconnaissance and surveillance (ISR) sensors.

Wind River
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[www.windriver.com].

GE Fanuc Embedded Systems to Acquire SBS Technologies

Marking the largest acquisition to occur in the embedded computer business in recent years, GE Fanuc Embedded Systems has agreed to acquire SBS Technologies. SBS Technologies shareholders will receive $16.50 per share payable in cash, for a total consideration of approximately $215 million net of SBS Technologies' cash and equivalents.

The combination of SBS Technologies and GE Fanuc Embedded Systems will create a broad presence in the industry, offering an extensive line of products ranging from embedded boards in multiple form-factors, bus architectures and fabrics to fully integrated systems available in a range of environmental grades. SBS Technologies itself had one of the industry's most vigorous acquisition runs, having purchased in the late '90s Greenspring, Bit3, Logical Design, VI Computer, OR Computer and others.

Concurrent with the announcement, Maryrose Sylvester has been appointed president and CEO of GE Fanuc. Sylvester expects the combined entity of GE Fanuc and SBS will have an excellent position serving the communications, medical imaging, industrial automation and military systems markets. In other GE Fanuc news, the company has announced that it has completed the acquisition of the technology assets of Condor Engineering. That acquisition was announced last month.

GE Fanuc Embedded Systems
Huntsville, AL.
(256) 880-0444.
[www.gefanuc.com/embedded].

SBS Technologies
Albuquerque, NM.
(505) 875-0600.
[www.sbs.com].

Data Translation Software to be Used for LXI Plug Fest

As a natural follow-on to its predecessors, PXI and VXI, the emerging LXI is becoming popular in military test and instrumentation projects. Using its DT Measure Foundry test and measurement software, Data Translation will participate in the multi-vendor systems demonstration to test and verify hardware conformance during LXI Plug Fest, scheduled for April 25-27 in Munich, Germany. LXI (LAN eXtensions for Instrumentation) is a next-generation, LAN-based modular platform standard for automated test systems. Data Translation will help to ensure that all equip-

ment works in conformance to the LXI standard. DT Measure Foundry software is an application builder package used by systems engineers to create automated test programs. DT Measure Foundry graphically represents instruments on the computer screen with built-in functions designed specifically for the test and measurement world.

LXI combines built-in measurement science and PC-standard I/O connectivity from rack-and-stack instruments with the modularity and size reduction of cardcage-based systems. With LXI, engineers are able to leverage the software and measurement accuracy they currently have from their GPIB instruments to the test system. The LXI standard provides a basis for long life cycle instrumentation implementations not limited by bandwidth, software or computer-dependent architectures.

Data Translation
Marlboro, MA.
(508) 481-3700.
[www.datatranslation.com].

LXI Consortium
[www.lxistandard.org].

Kontron Releases ETX 3.0 Adding Serial ATA to the Spec

Kontron announced the release of the ETX 3.0 specification for computer-on-modules (COMs). The new specification brings in 2x Serial ATA without changing any of the ETX pins, making new modules 100 percent pin-to-pin compatible with previous versions. These highly integrated COMs are targeted for medical, gaming and entertainment, military and aerospace markets.

ETX 3.0 modules integrate 2x Serial ATA via two slim line connectors that are designed onto the top-side of the CPU module itself rather than requiring the ETX-connectors of the module and carrier board to be redefined. As a result, existing carrier board designs can remain unmodified in order for the solution to take advantage of faster Serial ATA hard drives. ETX 3.0 also defines USB 2.0 to be used via the existing ETX connectors.

Kontron along with ADLINK, MSC and other supporting members of the ETX Industrial Group (www.etx-ig.org) have adopted ETX 3.0 with the intention of keeping the standard viable until at least 2010. Additional modules built around dual-core processors and others from Intel, AMD, and VIA are planned for release over the course of the year with more to follow. The ETX 3.0 specification will be available on the ETX Industrial Group Web site (www.etx-ig.org) in the near-term future.

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L-3 Telemetry Selects Aonix VM for Real-Time Data Acq System

L-3 Communications has selected the Aonix PERC Virtual Machine for the System 550 Real-Time Data Acquisition System. System 550 is the fastest and most complete commercial-off-the-shelf system available for real-time data acquisition, processing, distribution, control, display, analysis and archiving. System 550 is used in applications as diverse as flight test, satellite command and control, avionics test and integration, and space communications.

For the System 550 upgrade, L-3 selected the PERC VM to replace the existing Java VM in order to enhance performance and supportability while maintaining Java Standard Edition compatibility. PERC is the leading clean-room solution for embedded J2SE Java developers, featuring paced, reliable garbage collection, predictable performance and compatibility with a broad range of off-the-shelf components. First introduced nine years ago, PERC is the most widely used real-time Virtual Machine available for Java developers, with fielded installations in telecommunications, telematics, avionics, deep space exploration and office automation applications.

Aonix North America
San Diego, CA.
(858) 457-2700.
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Figure 2
This prototype of a JTRS HMS (handheld, manpack and small form fit) (formerly Cluster 5) radio represents one of as many as 14 radio sets or form-factors that could be called for under the JTRS program, each driven by an advanced radio core the size of a deck of playing cards.

General Dynamics Adopts Xilinx FPGAs for JTRS Modem Functionality

General Dynamics C4 Systems has selected the Xilinx Virtex-4 Platform FPGA for use in the development of handheld, manpack and small form fit products for the U.S. Department of Defense Joint Tactical Radio System (JTRS) military communications program.

General Dynamics C4 Systems is using the embedded digital signal processing (DSP) features of the device to enable critical modem functionality in the multi-functional radios, aimed at providing a more flexible and consistent communications platform for the U.S. military. Specifically, General Dynamics chose the Virtex-4 programmable platform for its ultra-low-power efficient DSP processing capabilities, a necessity for handling complex waveforms.

The handheld, manpack and small form fit radios developed under the JTRS program will transform joint service operations by providing communication flexibility and adaptability to fighting forces. By delivering three different power-efficient applications, the program will meet future battle needs for decades to come. As many as 14 radio sets or form-factors could be called for under the contract, each driven by an advanced radio core the size of a deck of playing cards.

Xilinx
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COTS Websites

www.calce.umd.edu

CALCE Website Excels in System Life Cycle Knowledge

In the defense electronics market, long design, development and system-maintained life cycles come with the territory. Nowhere is expertise on the subject of life cycle engineering more critical. Feeding such needs, the Center for Advanced Life Cycle Engineering (CALCE) Electronic Products and Systems Center (EPSC) is recognized as a founder and driving force behind the development and implementation of physics-of-failure (PoF) approaches to reliability, as well as a world leader in accelerated testing, electronic parts selection and management, and supply-chain management.

The CALCE EPSC is at the forefront of international standards development for critical electronic systems, having chaired the development of several reliability and part selection standards. The CALCE EPSC is staffed by over 100 faculty, staff and students, and in 1999 became the first academic research facility in the world to be ISO 9001-certified. Collectively, CALCE researchers have authored over 25 internationally acclaimed textbooks and well over 250 research publications relevant to electronics reliability. Over the last 15 years, the CALCE EPSC has invested over $50 million in developing methodologies, models and tools that address the design, manufacture, analysis and management of electronic systems. CALCE's website serves as portal and archive to all that knowledge. A recent addition to its collection is a study on the long-term impacts of lead-free electronics.

CALCE, University of Maryland,
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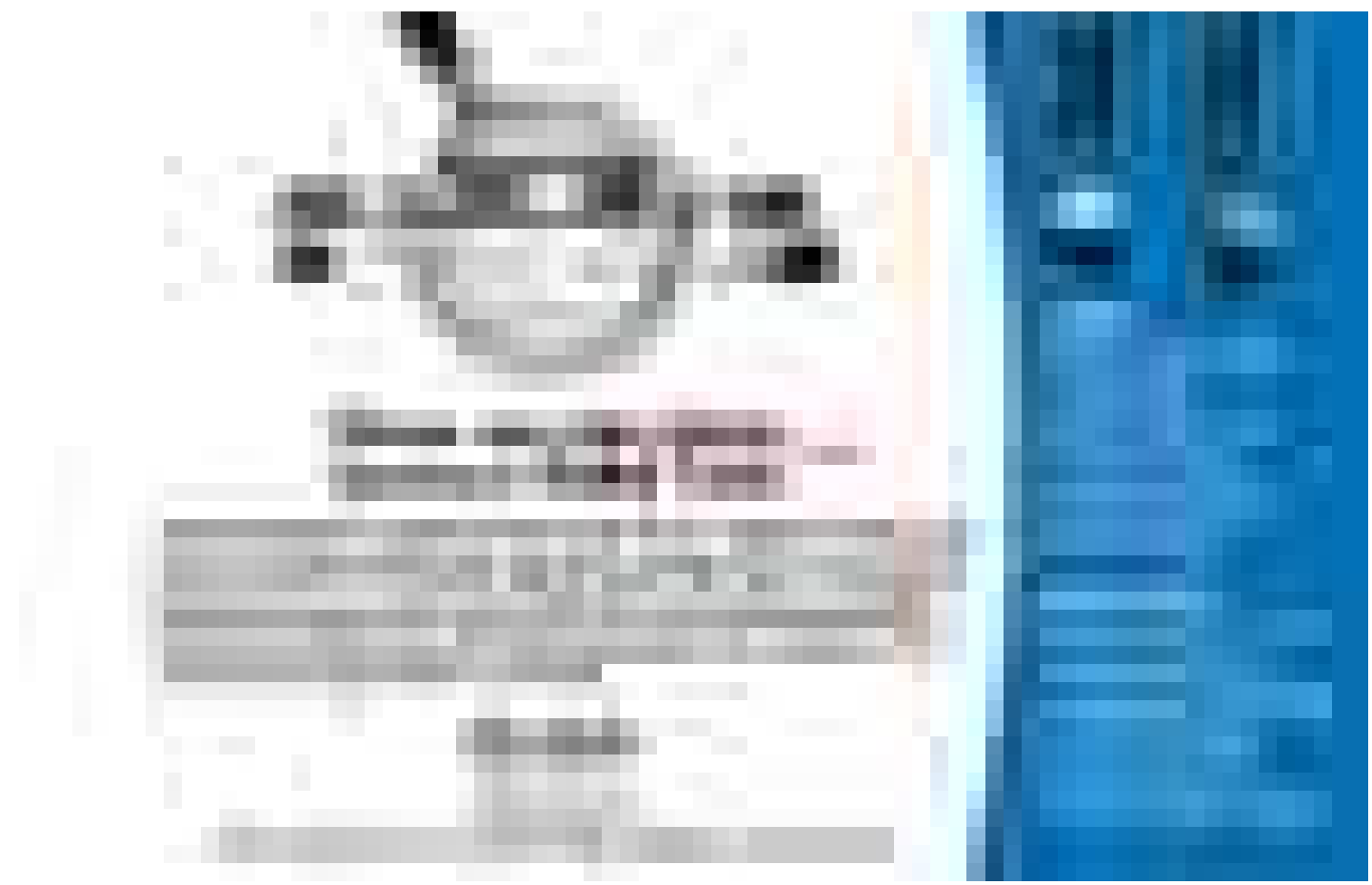

Program Briefing

Navy Fire Scout Lands Claim as Most Complex UAV in Development

Able to land without human control on an aircraft carrier at sea, the Navy's Fire Scout integrates a control system more complex than any UAV ever developed.

Jeff Child

For most air vehicles, first flight is typically the milestone that holds the greatest significance. Not so for the Navy's Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV). For it, the far more historic event happened in mid-January off the coast of Naval Air Station Patuxent River, Maryland when two RQ-8A Fire Scouts completed nine fully autonomous shipboard landings on board USS Nashville. During the two-day test two different Fire Scouts were used, which logged over nine total flight hours during the ship landings and takeoffs (Figure 1).

The test was ground breaking because it marked the first time a UAV performed vertical landings on a moving ship without a pilot controlling the aircraft. The Fire Scout has proved itself as more autonomous than any other tactical UAV that's out there flying now, according to Cmdr. Rob Murphy, the Navy's VTUAV integrated product team leader. "Because it flies on and off board ships, there's an added level of complexity and decision making that the mission plan has to take into account. There's no fixed landing point, so rather than flying based on GPS waypoints, the air vehicle instead returns to the area of the ship and commences to follow a relative flight plan based on its proximity to the ship."

Figure 1

In mid-January the Navy's RQ-8A Fire Scout tactical UAV made history performing the first autonomous landing aboard a Navy vessel at sea. The air craft is shown here as nears for landing aboard the amphibious transport dock ship USS Nashville (LPD 13).

For typical aircraft landing—whether rotary or fixed-wing—on a runway or any prepared site, an aircraft gets to rely on level ground that isn't moving. The vehicle knows how far away it is from its touchdown point. But when landing on a ship, you have to factor relative motion into the equation. The air vehicle not only must translate its closure rate to the landing spot in a different way, it must also take into account winds over the landing spot, including the "wind burble" that's created by the superstructure of the ship.

Autonomous Landing a Complex Challenge

While an air vehicle landing on a fixed-site need only orient its landing path into the wind, landing on ship

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requires the UAV to make corrections based on the relative motion of the ship. On top of all that, throw in the unpredictable nature of a flight deck at sea—the pitching, rolling and heaving of the deck—and the problem become even more of a challenge. The pitching and rolling deck presents a challenge because the aircraft won't be landing flat as it would on a fixed runway, so that typically one skid will touch down higher than the other. To ensure a normal safe landing, the system has to adjust the gains so that the power was taken off the aircraft in the correct proportion to weight being applied to the skids.

All that complexity requires a level of embedded computing power beyond that of any previous UAV. The Fire Scouts that flew in the January test were RQ-8As, which are a test version of the newer MQ-8B Fire Scout being developed by Northrop Grumman for the Navy and the U.S. Army. The MQ-8B Fire Scout is the aircraft element of a complete system called the Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) system. After it was launched from the naval air station, the Fire Scout flew to the designated test area, where the USS Nashville was waiting for the air vehicle to land and take off under its own control. The flight was monitored from a ship-based control station called a tactical control system, and the air vehicle was guided onto the ship using an unmanned air vehicle common automatic recovery system.

Second-Gen Fire Scouts in Development

Northrop Grumman is in the process of developing the second-generation Fire Scout, the MQ-8B, the first two of which were delivered in February to the company's new Unmanned Systems integration center in Mississippi. They are being integrated and are expected to fly before the end of this year. In contrast to the RQ-8A version, the MQ-8B brings a fourth blade and an increase in gross weight from 2,600 to about 3,100 lbs. Most of added the weight is for payload. The MQ-8B version also provides for a longer endurance, which meets the Navy's key performance parameter of launch, proceed 110 nautical miles, stay on station 5 hours and return.

The Fire Scout has been selected by the Navy as its Vertical Take Off and Landing Unmanned Aerial Vehicle for its new Littoral Combat Ship. In fact, the UAV has become a key enabler for that ship, and the LCS program is now a primary customer of the Navy Fire Scout. The missions are anti-submarine warfare, surface warfare and mine warfare, and Fire Scout has payloads that will contribute to all of those missions. The original vision for the Fire Scout VTUAV when it was started a couple years ago was for it to be used on an air-capable ship. To serve that need, the Navy and its program partners designed roll-on/roll-out shelters to provide the portable ground control stations for the Fire Scouts. With the advent of the LCS program, the ground control stations will be integrated and resident directly on the LCS ships.

Embedded computers and the payload interface unit aboard the MQ-8B are 3U CompactPCI boards supplied by SBS Technologies. Offering size, weight and power advantages compared to 6U VME, 3U CompactPCI has become a popular choice for UAV designs. Also on the air vehicle are three Rockwell ARC-210 Radios, with a growth path that accommodates substituting those for JTRS Radios when they become available. Rounding out the onboard avionics are Raytheon's Tactical Control System (TCS) and BAE Systems' IFF (Identification Friend or Foe) system. The Unmanned Combat Automatic Recovery System, residing on the ship, is supplied by Sierra Nevada Corp.

Army Fire Scout for FCS

The Army has also selected Fire Scout for as its Class IV UAV for its Future Combat Systems program. For the Army Fire Scout, Northrop Grumman provides just the air vehicle for Boeing and SAIC—the Lead System Integrators for FCS—while Boeing does the avionics, including a different control system than the Navy version and a different datalink. Although Fire Scout isn't technically a Joint Army/Navy program, the two branches are cooperating closely on it. An Army Lt. Col is embedded in the Navy program office (PMA). Eight Army Fire Scouts are under contract, with about one to be delivered per month for integration, starting last month. But while the Navy Fire Scouts are scheduled to go into services in FY 2008, the Army Fire Scouts, for now, will have to go into storage until the Future Combat System program can make use of them. ▮▮

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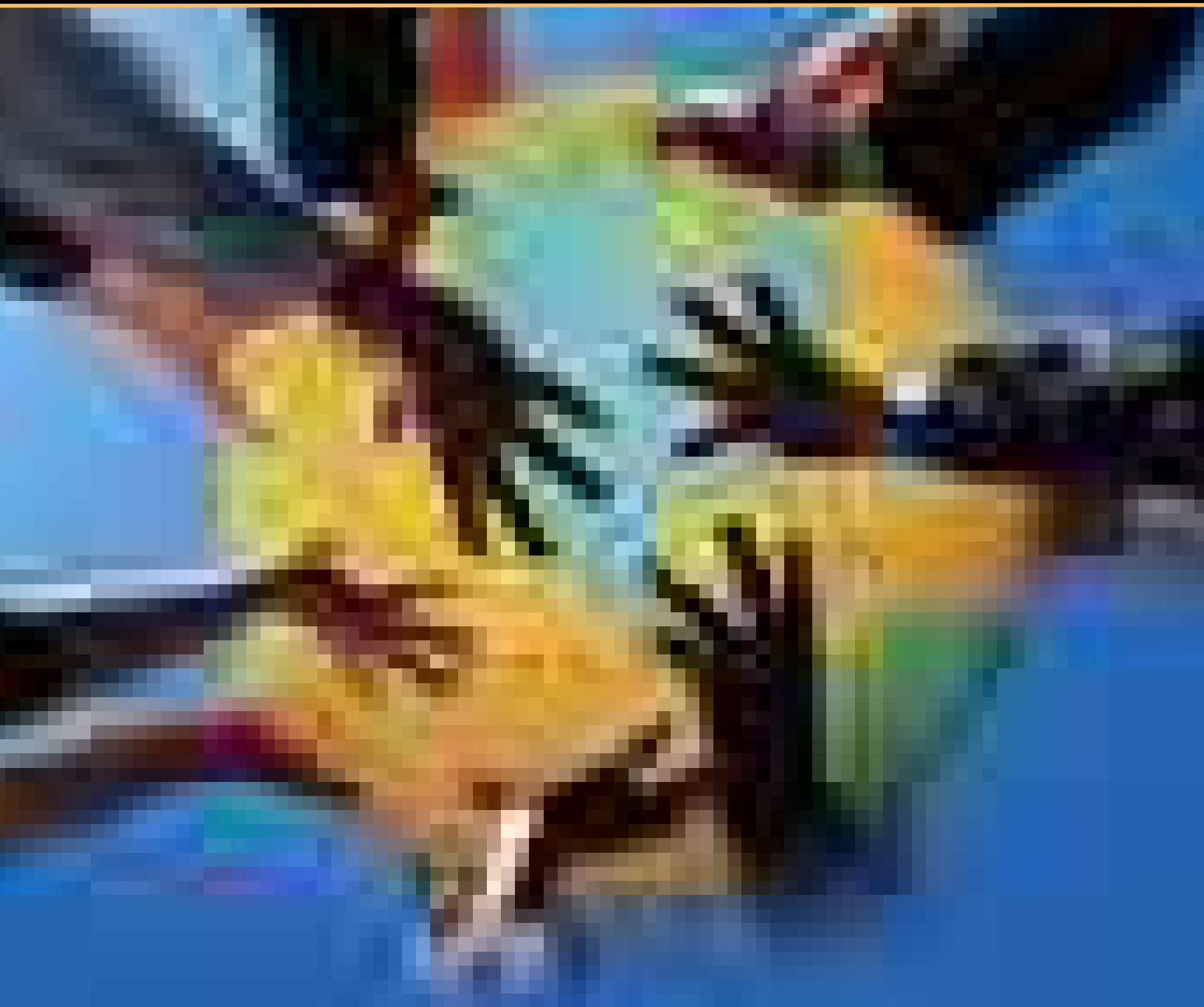

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Main Feature

PC/104 in the Military

PC/104 Keeps on Performing

Compact size, simplicity, mature technology and ruggedness keep PC/104 foremost in the minds of military system developers for embedded designs in small spaces.

Ann R. Thryft,
Senior Editor

The more deeply embedded the application, the more functionality is needed in a small space, along with long-term availability and high reliability. PC/104 is a technology that lends itself well to those needs, especially for the military, whether new designs or retrofits. Boards based on this form-factor are found throughout the range of embedded computing devices in military systems, in all service branches.

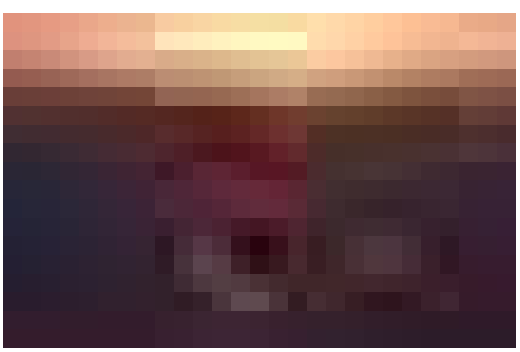

Figure 1

PC/104 boards give military systems a boost by providing mature technology, inherent structural ruggedness, compact size and easy maintenance. For embedded designs in small spaces, such as military radios, UAVs and aboard aircraft, developers are turning more frequently to this form-factor. Under the direction of the National Command Authorities, two MC-130 Combat Talons are shown off the coast of Florida, flown by the 16th Special Operations Wing. The SOW undertakes special operations in enemy-controlled or politically sensitive areas to support national security. *Photo by Staff Sgt. Andy Dunaway, courtesy of U.S. Air Force.*

PC/104's stackable design that eliminates the need for a backplane or a metal card cage, along with its pin-and-socket mating connector style, make it inherently rugged. Its wide vendor base, low power requirements and easy maintenance are also attractive to military engineers developing a variety of solutions, from portable electronics for the battlefield to UAVs to small systems that must fit into aircraft (Figure 1) or inside a missile launcher.

One of the key characteristics of PC/104 is the fact that designers can leverage chip and system architecture solutions that have first matured in the world of desktop PCs. All of the components that have first been developed, tested and manufactured for the commercial realm can be utilized for military designs, including processors, DMA, interrupts, timing, serial ports, network interfaces, video and disk storage.

For space-constrained military systems operating in harsh environments, the PC/104 architecture can be further ruggedized by several design techniques, as well as the use of thorough test and screening procedures, often provided by PC/104 suppliers. These include passive component selection, consideration of whether to derate/downclock processors, replacing sockets with soldered-on memory, manipulating memory refresh rates to prevent failures at extreme temperatures, the use of extremely conservative timing parameters and ensuring that a product is tested over the full temperature range.

Although PC/104 technology doesn't change much, there are a few different flavors, some of them recent. While a PC/104 card is, in effect, an ISA bus board reduced in size to 3.6 in. x 3.8 in., a PC/104-Plus module implements PCI on a stackable board that maintains the 3.6 x 3.8-inch form-factor and can include the original PC/104 connectors for the widest range of possible system configurations.

More recently, PC/104's larger and younger cousin, the EPIC form-factor, has gained popularity among military system designers since its appearance two years ago, for its size-to-performance ratio and superior thermal management. Just last fall, the EPIC Express specification was born, which adds high-bandwidth PCI Express I/O expansion to EPIC form-factor SBCs while retaining support for legacy PC I/O.

Thermal management is especially critical in military designs, because of internal reasons, such as hotter processors, as well as external environmental situations with high temperatures and the necessity of using conduction-cooling techniques rather than fans. The EPIC form-factor locates the processor out in the open away from I/O expansion boards that can be affected by its heat, and where it's more easily cooled. The larger EPIC board size, at 4.528 in. x 6.496 in., also allows mounting holes for a cooling arm on the CPU's sides. ▮▮

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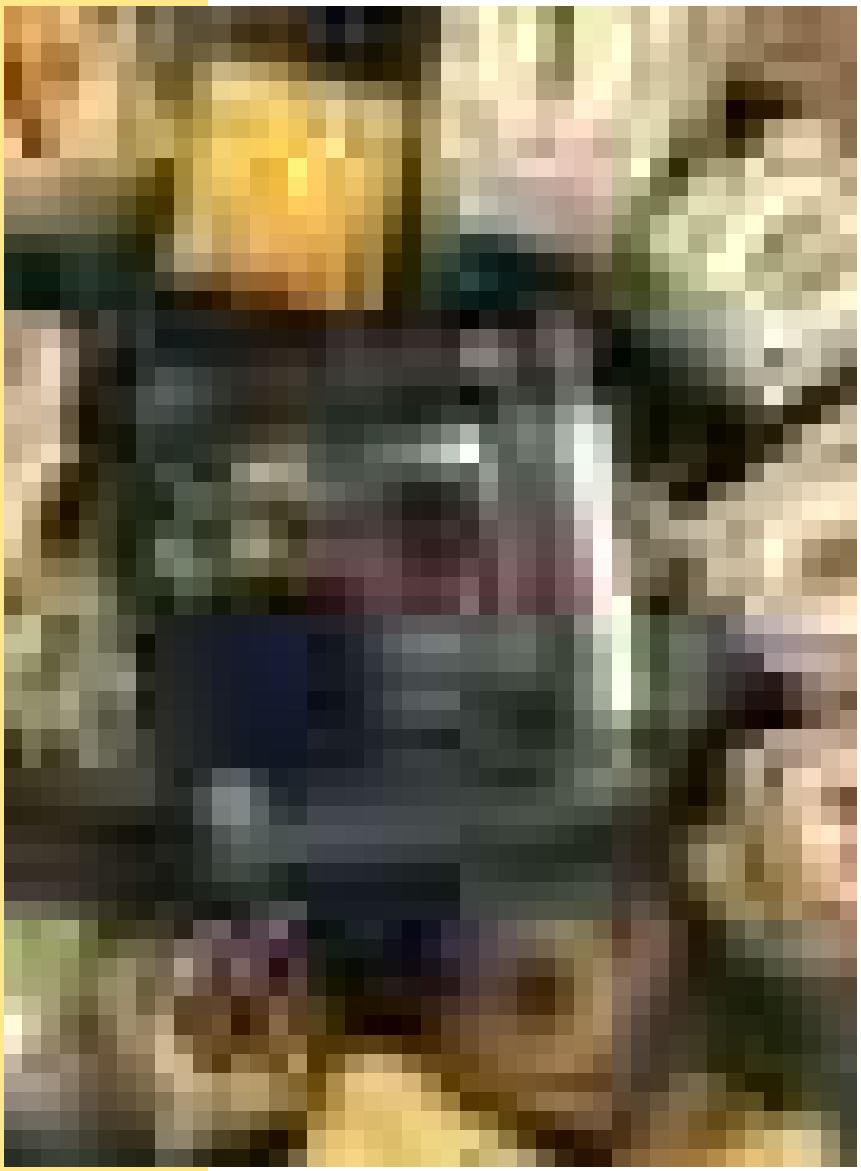

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Enabling Ruggedized IP Networking in Net-Centric Operations

The combination of PC/104 hardware with Cisco IOS software and the Mobile IP specification facilitate the creation of net-centric applications for military use, allowing mobile units to maintain consistent logical addresses for easy communications.

Andrew Hunt, Director of Business Development and Bart Robison, Sales Application Engineer, Parvus

The military trend toward net-centric operations—linking field resources together using Internet Protocol (IP)-based networking—requires that ruggedized IP nodes and servers be available for constructing the network. Further, these units must be portable and capable of utilizing many different communications channels. A commercial-grade solution to mobile networking that uses PC/104 is available that provides rugged IP networking elements for mobile applications.

The U.S. military sees net-centric operations as a compelling mechanism for coordinating diverse resources in field operations. Using IP-based communications, virtually every vehicle, plane and soldier becomes a node in the network and can share data. With this massive data sharing, field and strategic commanders could obtain real-time situational awareness for tactical planning, deployed units could have immediate access to intelligence information and both troop and enemy movement could be tracked across an entire battlefield. It would also allow direct, secure voice-over-IP (VoIP) between any two members of the network despite differences in the communications platforms they utilize.

Mobile IP Networking Equipment

Networking equipment that can meet the demands of battlefield deployment must satisfy several criteria. It must be rugged, that is, able to handle temperature extremes as well as severe mechanical shock and vibration. It must also be portable, since both space and weight are significant concerns in military equipment. The equipment must be compatible with a wide range of communications platforms, including wireline, spread-spectrum RF, optical and satellite links. Finally, to meet the modern military's budget constraints, the equipment must be based on commercial-grade technology.

As a result, the distinctive advantages of PC/104—compact size, PC compatibility, strong vendor support, stackable design, low-power requirements, environmental durability and simple maintenance—make it an ideal foundation for building

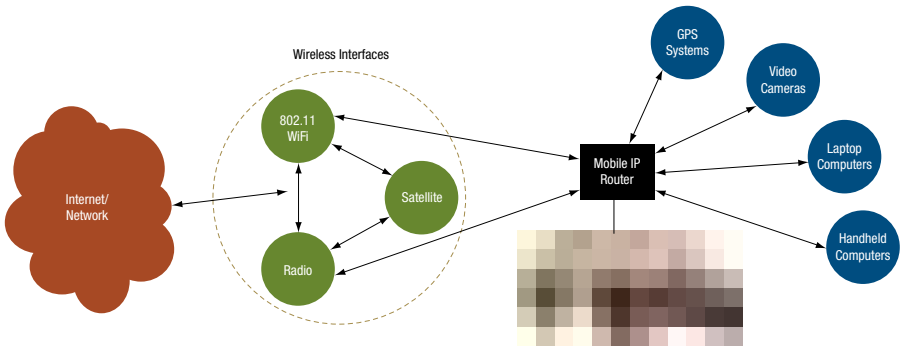

Figure 1

Mobile IP networking allows an entire vehicle network to stay connected by enabling transparent roaming and always-on connectivity across wireless coverage areas.

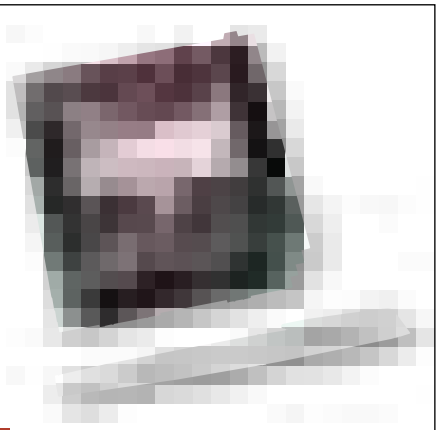

Figure 2

The Cisco 3200 Series Wireless and Mobile Router was the first step in enabling ruggedized Mobile IP, using PC/104 technology to achieve a compact size.

Mobile IP networking solutions.

The beginnings of commercial solutions to net-centric applications arose with the introduction in 2002 of the Mobile IP specification (RFC 2002) by the Internet Engineering Task Force (IETF).

Before RFC 2002, when a mobile node moved from one local network into another, the node's IP communications channel with the wide area network terminated. The new network's server then had to establish its own communications channel and assign a new IP address to the node. This not only interrupted the mobile node's communications through the network, it changed the return path address so that other nodes on the wide network could no longer find the mobile node. All such links needed to be re-established each time the mobile node changed local networks.

The Mobile IP specification allows a mobile node to roam across multiple local networks while maintaining continual communications with, and a consistent IP address for, the wide area network (Figure 1). This attribute greatly facilitates communications among nodes by giving each node a unique address that does not change with movement and by preventing the continual breaking of, and need for reconnecting, links between nodes. The mobile node thus can roam seamlessly across networks, effectively behaving as though it were stationary.

The creation of the Mobile IP specification made it possible for Cisco Systems to develop the Cisco 3200 Series Wireless and Mobile Router. Cisco 3200 Series Routers run Cisco IOS software and enable the networking of multiple wireless devices running any variety of communications links. For instance, the routers can tie together nodes that use cellular telephony, WiFi (802.11 Ethernet) and satellite communications into a single network. Each node is free to roam anywhere these links provide coverage, switching links as needed, without losing its unique IP address.

Cisco originally developed the Series 3200 Router platform using VME hardware, and then redesigned it with PC/104 components to provide a rugged, more compact and lower cost system (Figure 2). These PC/104 components are well suited to the unique requirements of Mobile IP networking, where shock, vibration and other environmental extremes could destroy a system based on open desktop technology.

Enabling Ruggedized Mobile IP

Another step in enabling ruggedized IP communications came when Parvus packaged Cisco's boards in a rugged enclosure designed for the hostile environment of transportation installations. This ruggedized Mobile IP access router, the DuraMAR, includes a 150W power supply that accepts a wide range of input DC and provides isolation against voltage spikes and transients (Figure 3). It was created for use in transportation equipment such as buses and trains, but is equally applicable to use in military transport.

Because a router by itself is not enough to provide a network link, this ruggedized Mobile IP access router was designed with a distributed architecture that enables the connection of peripheral devices, or nodes, to provide the radio and other communications links as well as end user nodes. The ruggedized router uses Power over Ethernet (PoE) and Power with Serial (PwS) to supply power to these peripherals, simplifying their installation and use in a variety of configurations. Nodes can be a long-range communications channel to the main network, a LAN controller for creating a local wireless network or peripheral equipment that needs a network connection.

Ruggedized, Mobile IP networking is a proven concept. The DuraMAR series, for instance, has been used in field trials with a major metropolitan transit authority for linking trains into a network. The systems replace a modem connection on the train and provide connections to sensors and monitoring systems in the train. This allows central dispatch to monitor the trains' conditions in real time as they move through

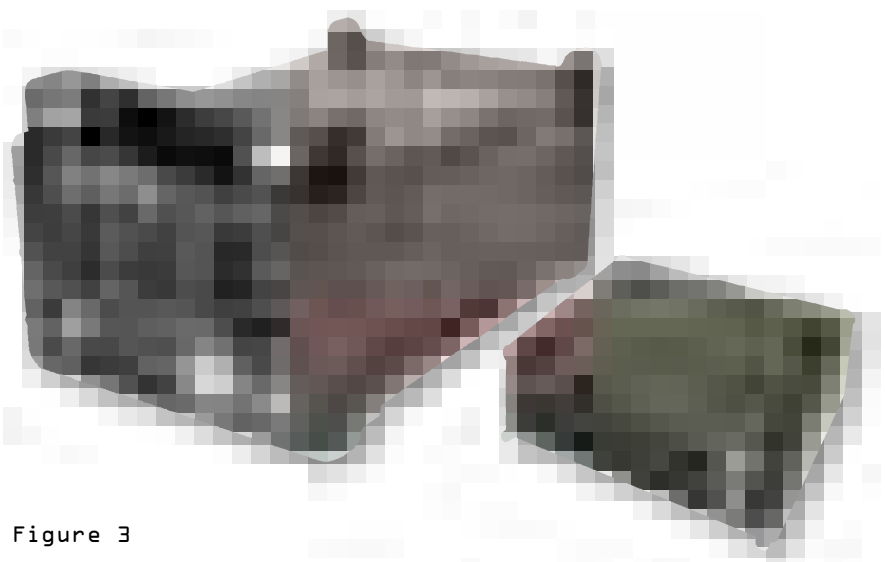

Figure 3

The DuraMAR system from Parvus provides a rugged enclosure and robust power supply for the mobile router, and simplifies the connection of other equipment by supplying Power over Ethernet to peripherals.

the rail network, helping ensure passenger safety and providing early warnings of maintenance requirements.

Industry standard environmental tests have been conducted, including temperature, shock and vibration, as well as shallow immersion. Through the use of conductive cooling and elimination of all moving parts, not only will the ruggedized Mobile IP access router withstand these harsh environments, but its MTBF will be considerably higher than previous solutions.

Ruggedized Mobile IP for Net-Centric Operations

The availability of commercial-grade, ruggedized, Mobile IP networking opens up a wide range of possibilities for military applications. For example, the DuraMAR is being deployed aboard Black Hawk helicopters for equipment monitoring and secure communications using IPsec and other encryption modes. Shipboard applications are also being evaluated.

Several other applications are also possible. A vehicle such as a HUMVEE can be outfitted to provide a mobile WiFi hotspot for field communications. This capability gives human-transported field equipment the opportunity to use WiFi as its basic communications link and connect to the network through satellite or other long-range links that may be offered via the vehicle. Field equipment no longer must be burdened with multiple communications choices, or retrofitted as long-range links change.

Aircraft can use VoIP for voice communications with central command, utilizing whatever radio links it currently has available. The need to break communications to switch channels or to switch to another type of equipment is eliminated.

Central facilities can use the network to monitor the status of field equipment in order to provide just-in-time support, such as scheduling refueling for vehicles and aircraft.

Remotely piloted and autonomous surveillance vehicles can broadcast their data to the network, allowing field troops to access real-time intelligence about battlefield conditions, including live video, as they need it.

For all of these applications, PC/104's modular architecture enables the use of application-specific functionality—such as a wireless modem, Ethernet switch, WiFi interface or MIL-STD-1553 interface card—to create a distributed architecture for mobile networking that supports a wide variety of applications.

Because all equipment connects together over the IP network, it does not have to be directly compatible. A WiFi laptop can thus serve as the communications instrument connecting command to field troops, regardless of the type of radio being used in the field, as long as each can connect to the network via its own method.

Eliminating the need for direct compatibility also allows ruggedized Mobile IP networking to support legacy systems by creating a bridge device. Systems using buses such as CAN, 1553 and LonWorks can then connect through the IP network, reducing the need for cabling and extending the system's useful lifetime. Connection through the Mobile IP network also extends the legacy system's flexibility in terms of its ability to provide data and to be controlled by remote operators and other, previously incompatible, information systems.

By providing IP-based equipment with seamless roaming across networks, the Mobile IP specification sets the stage for net-centric military operations. Using IP as the base protocol, any equipment that can connect to the network can then connect with any other equipment on the network. Ruggedized mobile routers, such as the Mobile IP access router, provide the nucleus for systems that can link that equipment to the network through any of multiple communications channels and maintain that connection while in motion. Both field and base units remain connected in a network that can flex and range across the battlefield, but which structurally remains intact and unchanged. ▮▮

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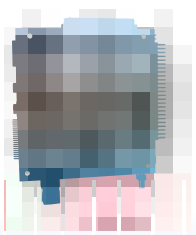

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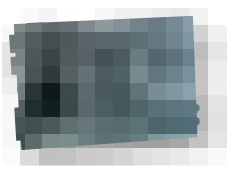

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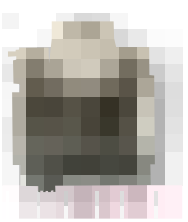

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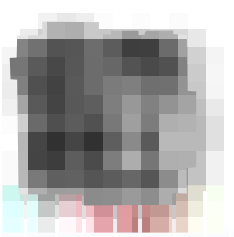

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Main Feature

PC/104 in the Military

Ruggedizing PC/104 Boards for Military Applications

The inherently rugged PC/104 stack architecture can be made even more reliable with several features, plus design and screening techniques, for space-constrained military systems operating in harsh environments.

Paul Rosenfeld, Vice President, Marketing
Diamond Systems

Since its inception in 1991, PC/104 technology has been embraced by military systems engineers for a wide range of applications, from pilotless drones to missile launchers to military radios. Many engineers select PC/104 because its ultra-small, 3.55-in. x 3.775-in. form-factor enables an off-the-shelf solution for applications that may previously have been possible only with a custom CPU design. For example, the small size allows PC/104 CPUs, and even complete multi-board systems, to be placed in the nose cone of a missile or fit nicely inside a small UAV.

Other military engineers select PC/104 technology because of the ruggedness inherent in its stacking architecture (Figure 1). This unique approach to multi-board systems provides for a shock- and vibration-resistant off-the-shelf computing solution by eliminating backplanes and metal card cages, making PC/104 ideal for military vehicles such as tanks or even HUMVEEs. Finally, the light weight of PC/104 systems make PC/104 an ideal architecture for portable systems carried by soldiers, such as military radios.

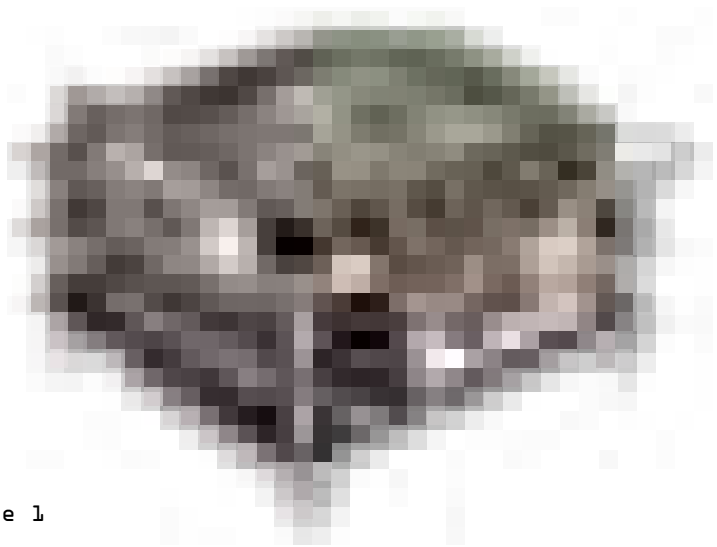

Figure 1

PC/104's shock- and vibration-resistant ruggedness is inherent in its stacking architecture. This unique approach to multi-board systems eliminates backplanes and metal card cages, making PC/104 ideal for military vehicles such as tanks and HUMVEEs.

Ruggedizing PC/104 Boards for Extreme Temps

Features not inherent to PC/104 itself, but which are provided by many PC/104 suppliers, make the technology even better suited to military applications. The inherent ruggedness in the PC/104 mechanical design can be enhanced by using boards that have been designed and tested for extended temperature operation. Many PC/104 boards are rated from -40° to +85°C. The ability to withstand cold temperatures is a requirement for operation in an aircraft at high altitude. On the other end, high temperatures can occur in a sealed enclosure sitting on the ground in a desert.

Developing boards that run reliably at such extreme temperatures is a challenge when fundamental elements such as the CPU and chipset may not be rated at such extreme temperatures. Dissipating heat from a 5W to 15W CPU under such circumstances takes skill and an outstanding design.

Figure 2

Extended temperature testing provides sufficient confidence to specify a product over the full temperature range and to guarantee operation at these extremes over the entire warranty period. For the highest confidence levels, some PC/104 vendors, including Diamond Systems, offer optional extended temperature screening of each product shipped.

Several suppliers offer a number of PC/104 CPUs and I/O boards rated to run over the full extended temperature range of -40° to +85°C. Although many of these boards use some components rated by their manufacturers for only 0 to 70°C operation, certain design techniques can make extended temperature operation feasible.

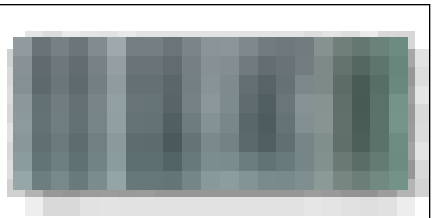

Figure 3

Replacing DIMM sockets with a different type solves some vibration problems that can lead to memory failures. However, the use of soldered-on memory (Figure 3) represents the best possible solution, since it eliminates the source of the problem altogether.

Components, Board Design Help Ruggedization

First, board suppliers have developed broad experience with a wide range of passive components to understand which components can be expected to perform well outside their rated temperature ranges. The key to designing with passive components is to analyze the temperature effects on their key parameters and then design the circuit to operate reliably under worst-case conditions. In addition, more expensive tantalum capacitors are preferred over the aluminum electrolytic capacitors found on commercial-grade boards.

But component selection is only part of the battle. Board design must also incorporate very conservative timing parameters, particularly with respect to low-temperature operation. More attention is paid to matching trace lengths and matching impedance on multi-pin interfaces between components. This can be particularly important on high-speed interfaces such as the front-side bus between the CPU and the Northbridge or the memory bus between the Northbridge and the memory components.

For ICs, a common but not universal rule is that derating such as downclocking processors or using logic chips at speeds much slower than their specified performance can often yield an increase in the reliable operating temperature range. In this case, performance may sometimes be sacrificed in favor of reliability. This is a judgment that must be made by both the designer and the customer.

Finally, these boards may have more layers, providing greater spacing between traces and more room for copper layers to pick up and dissipate some of the heat. As a final step, the memory refresh rate may be manipulated in the BIOS to prevent memory failures at the temperature extremes.

But merely designing a product according to these types of design rules is not enough. From the very earliest prototype, a product must be exercised over the full temperature range. Design tweaks aimed specifically at broadening the product's operating temperature range may often be tried out.

It is important to have extensive experience in testing multiple boards operating for a considerable time at the particular temperature extremes, in order to gain sufficient confidence to specify a product over the full range and to guarantee operation at these extremes for the duration of the warranty period. However, even this may not always be enough. In some cases, there may be sufficient variances in component performance to make it desirable to test each and every product shipped over the full temperature extremes. Some PC/104 vendors, including Diamond Systems, offer optional extended temperature screening of each product shipped to provide the highest level of confidence (Figure 2).

Resistance to Shock and Vibration

A second feature highly valued in military systems is resistance to shock and vibration. The stacking PC/104 architecture provides the basic elements that enhance the performance of a PC/104 stack in such applications. When implemented with four metal standoffs at each of the four

corner mounting holes, a PC/104 stack is extremely rugged. But a rugged stack that stays together is not enough if the system fails due to jumpers coming off or socketed memory DIMMs vibrating loose.

In general, all sockets should be eliminated in a rugged design. For example, in one real-world application, a DIMM memory module was held down by a strap. However, it vibrated sufficiently within its socket that the socket contacts lost tension over time. This resulted in intermittent memory failures in the field a year or more after initial deployment, creating a very difficult and expensive problem to diagnose and repair.

In this case, replacement of the DIMM socket with a different type solved the problem. However, the use of soldered-on memory (Figure 3) represents the best possible solution, since it eliminates the source of the problem altogether.

Similarly, although a configuration jumper, or shunt, on a board may represent a cost of less than a penny, jumpers are available with differing tension and plating characteristics. In addition, after being subject to continuous shock and vibration, over time shunts lose their grip. In a production system, which is unlikely to change, the most secure way to fix a board configuration is by hardwiring the jumper. This can be done with either a soldered wire strap or, preferably, with a zero ohm resistor. Many PC/104 suppliers make such a configuration option available to their customers by building footprints for these configuration resistors right onto the PCB (Figure 4).

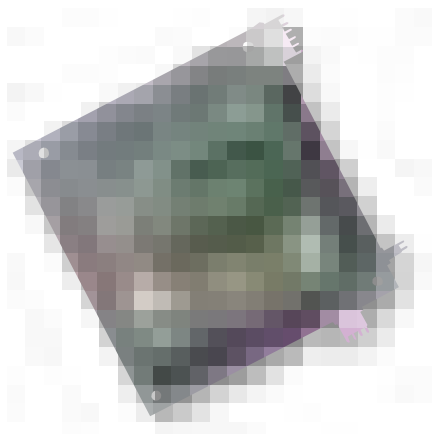

Figure 4

Diamond Systems' Elektra PC/104 CPU incorporates many ruggedness features, including extended temperature operation, soldered memory and optional hardwired configuration jumpers, along with onboard data acquisition.

Ruggedizing a Weapons Station

The role played by these capabilities, which are available with many PC/104 solutions, can be best seen in a real-world application.

A leading defense contractor was developing a weapons station to remotely control light- and medium-caliber weapons that can be installed on any type of military vehicle. The system required a small form-factor computing platform with full analog, digital and serial I/O, as well as a display interface.

The customer selected a PC/104 CPU with IDE flash disk storage from Diamond Systems, due to its extended operating temperature range and integrated data acquisition capabilities. Since the vehicle would likely see action in extreme environments such as water, sand and high temperatures, the customer requested conformal coating for the PCB and flash disk.

It was also anticipated that the system would be exposed to extreme shock and vibration. Soldered memory on the CPU board was essential for this application. However, the customer's requirements called for changes to the standard product in order pass MIL-STD-810 shock and vibration standards.

Standard connectors were therefore replaced by latching connectors with increased contact plating. The PC/104 connector was replaced by a high-reliability MIL-style connector. Selector shunts were replaced with zero ohm resistors to eliminate any possible dislodging of the shunts due to vibration or misapplication. Finally, to counteract the effects of extreme vibration over and above that of the MIL-STD-810 vibration specification, all of the BGA chips were underfilled to eliminate any solder bond cracking between the board and the BGA balls.

In order to assure consistent and reliable thermal management in this rugged, high-vibration environment, Diamond Systems' engineers worked with the customer to create a custom heat sink. This heat sink would equalize vibration resistance by positioning several legs around the PCB. The heat sink utilized a thermal contact pad to eliminate the effects of shock and vibration from being transferred to the BGA chips from the heat sink. After extensive testing, the solution successfully passed all of the higher vibration test requirements.

This weapons station application demonstrates how the capabilities inherent in PC/104 architecture rugged interboard connections and small size make PC/104 architecture suitable for vehicle-based and airborne military applications. It also demonstrates how particular features and capabilities added by suppliers of PC/104 CPU and I/O boards go the extra mile to fit the specific needs and requirements of military systems.

Design considerations such as component selection, PCB design and component derating contribute to a product's reliability. Extra features add to the ruggedness of these boards, such as an extended operating temperature range, conformal coating, additional ruggedness through elimination of jumpers, latching connectors, soldered-on memory and burn-in or temperature screening of each board shipped. These techniques ensure that PC/104 technology continues to maintain a leadership position in military applications challenged by limited space and harsh operating environments. ▮▮

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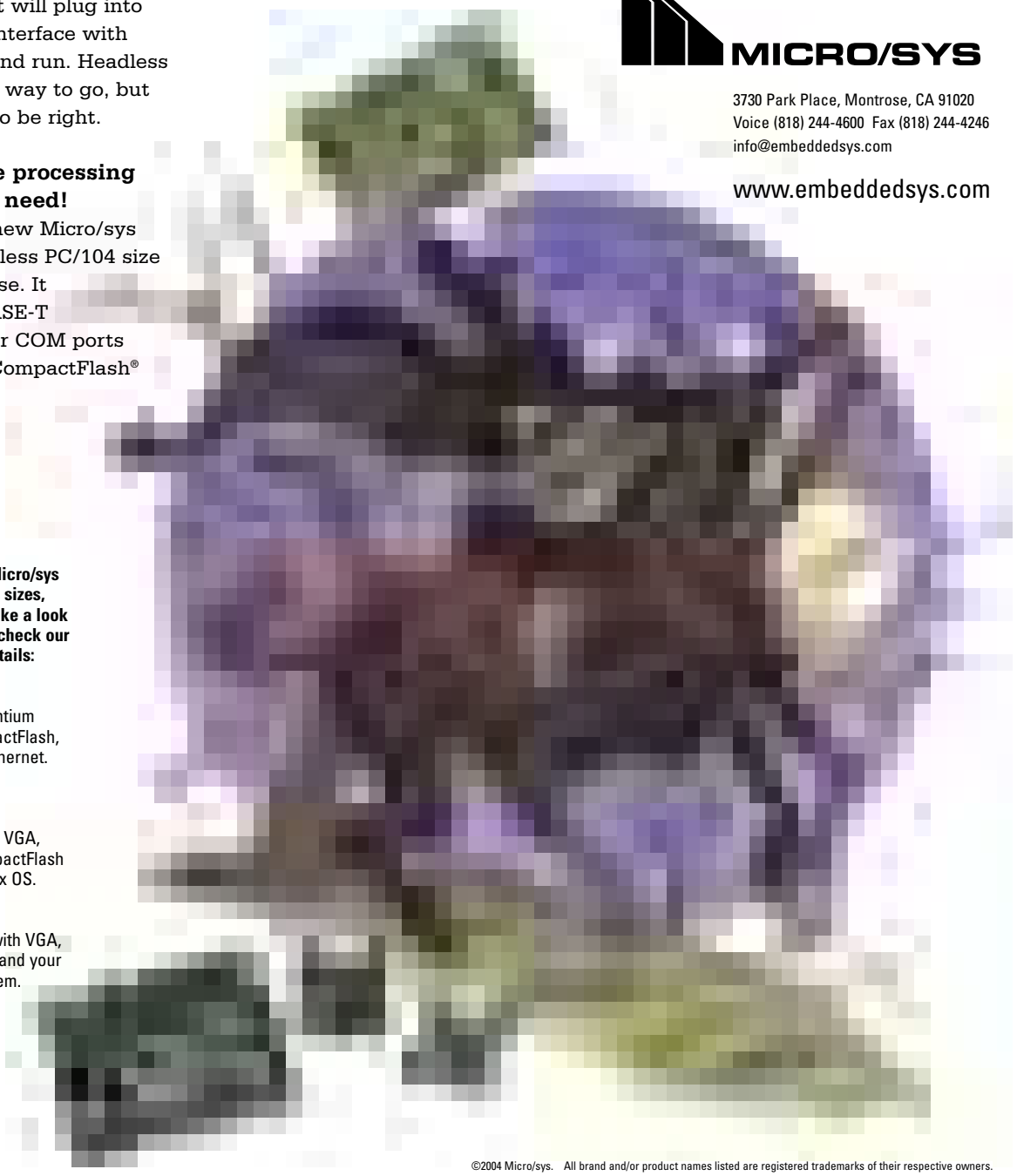

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Tech Recon

VME for the Next 25 Years: Part II

Industry Execs Foresee Strong Future for VME

Twenty-five years old and still thriving, VME remains a force in military embedded computing. Can it sustain that momentum for the next 25 years as computing shifts away from parallel bus schemes toward switched serial approaches?

Jeff Child

Celebrating its 25th birthday this year, VME has much to be proud of. No other bus architecture and form-factor in the history of embedded computing can boast the longevity achieved by VME. Beyond just the neat trick of achieving the all-important "critical mass" early in its lifespan, VME managed to sustain that momentum and critical mass through multiple technology transitions and market cycles. VME technology is found in thousands of applications and has shipped more than 25 million products, with the military ranking as its top market.

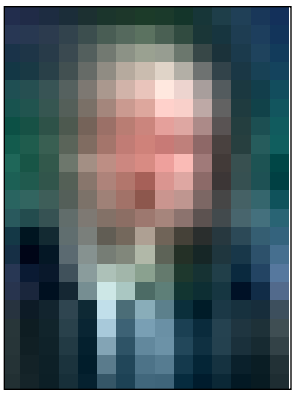
Blessed with an extremely effective trade association and standards organization—VITA and the VITA Standards Association—, VME has thrived by evolving to incorporate the latest technologies—both mechanical and electronic. That said, the lifeblood of VME has been the vigorous support of VME product suppliers that have keep growing the portfolio of products available in the VME form-factor. Individuals at those same companies, through VITA and the VSO, pooled their expertise in developing a steady stream of add-on specifications to VME.

As the industry looks ahead to the next 25 years, VME is becoming a potential casualty of the transition away from parallel bus architectures, toward serial and pseudo-serial switched fabrics. Those serial fabrics have begun to take their place alongside, and in hybrid configurations with, parallel backplane designs targeted for embedded computers in military applications. And while emerging VITA specs like VXS (VITA 41) and VPX (VITA 46) aim to blend fabrics into the VME universe, they foretell a definite move away from traditional parallel bus schemes like VME64 and VME 2eSST. A valid question arises as to whether such hybrid or fully switched serial can truly be called VME.

Such questions are probably moot, if VITA has any control over the matter. In its marketing efforts, VITA has already begun to broaden its scope by expressing the "V" in VITA as applying to more than just VME. It's likely that, even decades from now—when traditional parallel VME bus fades from view—"VME" will survive as a platform for sophisticated, self contained packaging system with integral power management, cooling and some standardized way of slotting in megachip-based I/O modules.

Meanwhile, Tundra Semiconductor states that they fully intend to follow the VITA roadmap with VME interface chip products. Tundra's Universe VME interface chips dominate the installed base of VME board products now deployed. In recent months Tundra introduced the Tsi148, a PCI-X-to-VME bridge, and just last year they added an industrial version of that VME 2eSST-enabled bridge.

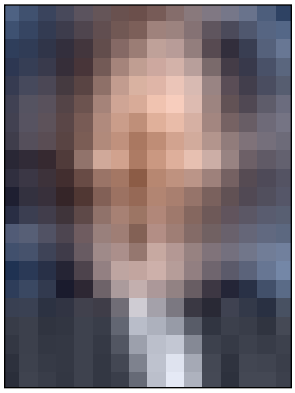
In last month's issue, *COTS Journal* presented Part I of this special "VME for the Next 25 Years" feature section. Part I examined how the VME community is providing military system designers an upgrade path by blending switched fabric technologies with VME into the latest VITA specs. Here, in Part II, we've collected insights on the next 25 years of VME from eleven top executives from VME single board computer suppliers in the defense market. The executives included are not meant as an exhaustive list, merely a representative one. Also included along the bottom of these pages is a timeline illustrating the details of where VME has been and where it's going.



"With its foundation in open-system architecture and the longevity that it brings to the embedded computing market, VME is certain to continue to expand in its capabilities, performance and programmatic adoption into worldwide defense and aerospace applications. Over time, emerging standards such as VXS (VITA 41) and VPX (VITA 46), will help to move open-systems architectures—including VME—into many new areas. As that happens, the appeal of open-systems architectures will broaden and continue to differentiate these off-the-shelf solutions into even more diverse areas."

- Doug Patterson, V.P. of Worldwide Sales and Marketing
Aitech Defense Systems

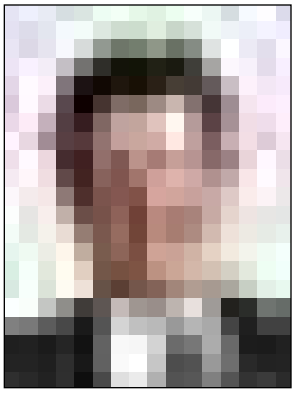
Aitech Defense Systems, Chatsworth, CA. (888) 248-3248. [www.rugged.com].



"We believe that VME is, and will remain, one of the embedded market's significant standards and that those who support it will continue to gain financial benefits enabling on-going investments in new products and standards development. VME has proven, almost uniquely, that it is able to continue to grow and succeed through evolutionary enhancement. The most recent example of the revitalization process is the VPX (VITA 46) standard. Similar technology drivers are inducing CompactPCI to evolve. We see many CompactPCI users migrating to VME because of the solutions made possible by VPX. VME will not merely survive, but will in fact garner even greater support as users migrate to it from both proprietary in-house and competing standards."

- Tom Quinly, President
Curtiss-Wright Controls Embedded Computing

Curtiss-Wright Controls Embedded Computing, Leesburg, VA. (703) 779-7800. [www.cwcembedded.com].

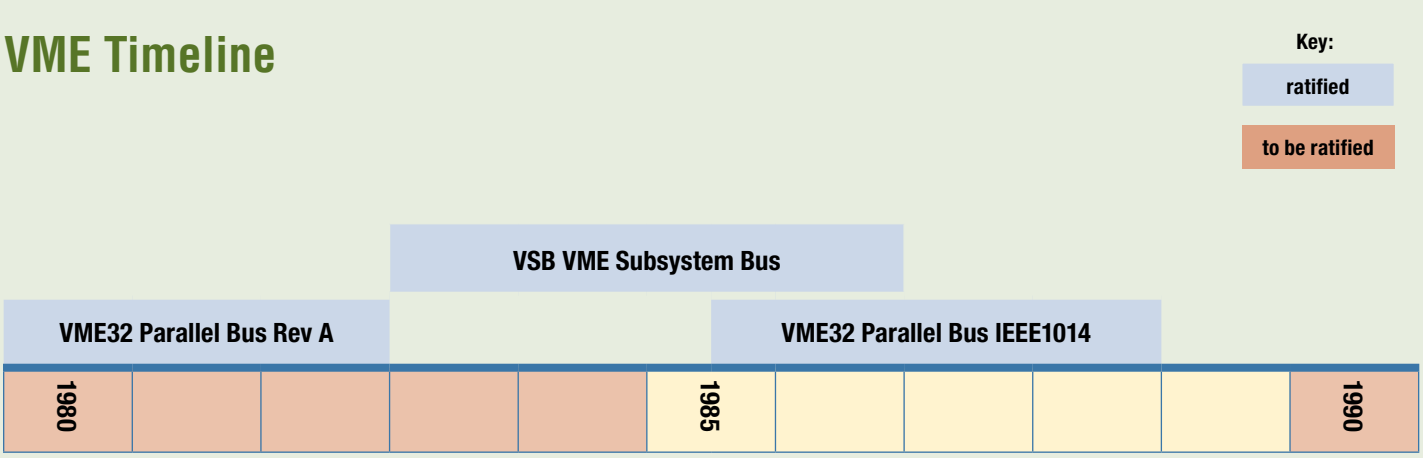


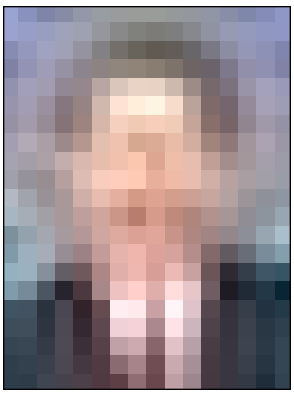
"Based upon the number of new long-term programs we're seeing, VME should be around for a long time to come. We are excited about many of the new standards including VITA 46. With all of the new bus standards that have come and gone over the years, VME seems to have the most integrity with regard to backward compatibility while continuing to support ever higher performance. This resonates very well in the COTS market."

- Mike Horan, President and CEO
Dynatem

Dynatem, Mission Viejo, CA. (949) 855-3235. [www.dynatem.com].

VME Timeline





"I'm very excited about the new standards that are evolving today that will take VME into its next 25 years. With high-speed serial fabrics such as PCI Express and Serial RapidIO augmenting the proven capability of the existing VME standard, we have a very robust and scalable architecture. Hybrid standards such as VITA 46 that provide support for legacy VME64, as well as current and next-generation serial fabrics, provide the best of both worlds and will provide the needed bandwidth for next-generation compute and data intensive systems."

- Jim Berlin, Vice President of Hardware Technology
GE Fanuc

GE Fanuc Embedded Systems, Huntsville, AL. (256) 880-0444. [www.gefanuc.com/embedded].

"VME will go through an evolution with the new VXS standards. VXS will provide the customer base a migration path to deploy the fastest, most reliable technologies, at the lowest total system risk and cost. We've always believed in VME and will continue on the VME/VXS path. It's still the BEST system solution in the world."

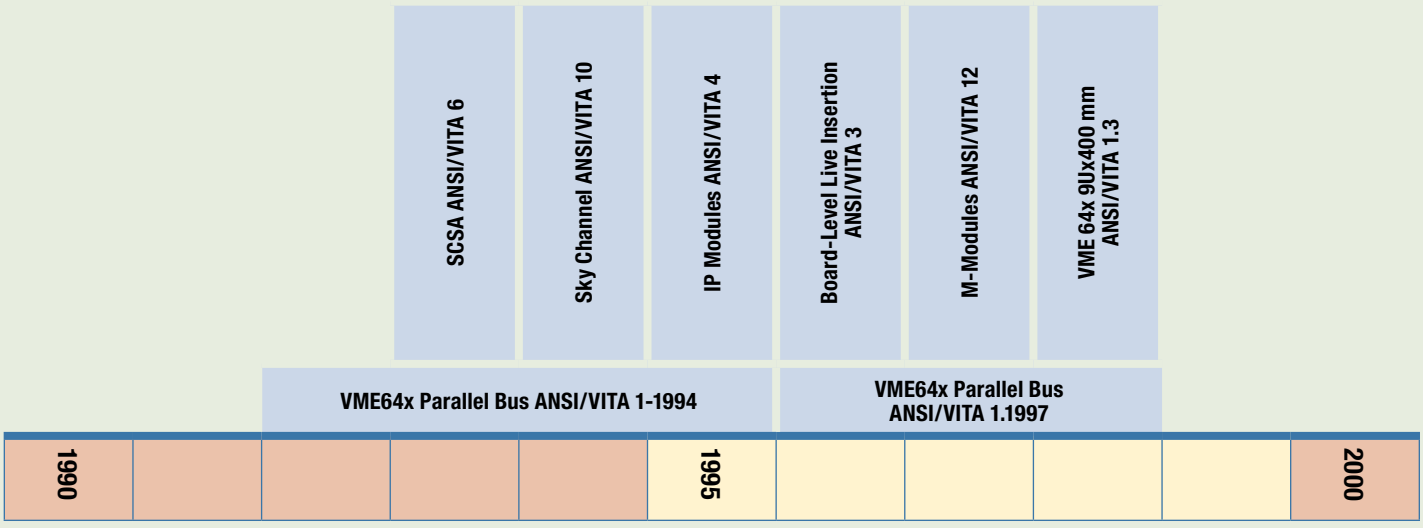
- Ben Sharfi, President
General Micro Systems

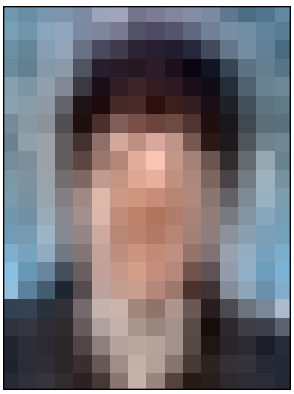
General Micro Systems, Rancho Cucamonga, CA. (909) 980-4863. [www.gms4sbc.com].

"Mercury sees a continuing roadmap for VME both in high-end systems with hundreds of processing elements and miniature systems that pack tremendous functionality into small, low-power modules. VME continues to assimilate new capabilities: next-generation fabrics like RapidIO, Linux and other open-source software and heterogeneous processing including FPGA computing, PowerPC 8641 and the Cell Broadband Engine processor. Ultra-rugged implementations based on VPX and REDI (VITA 46/48) will complement VXS (VITA 41) in converting today's still proprietary systems to capable COTS solutions. These unmistakable trends will enable the mission system vendors to revolutionize warfare by delivering fused-sensor data, on-demand to any field operative at any location."

- Jay Bertelli, President and CEO
Mercury Computer Systems

Mercury Computer Systems, Chelmsford, MA. (978) 256-0052. [www.mc.com].

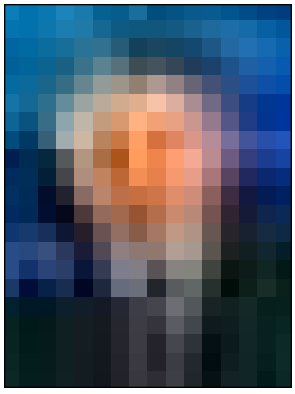




"The most significant growth opportunities are arising in the communication of data from traditional VME applications over global IP public and private networks—while preserving the essential qualities that have made VME so successful in the past. A combination of traditional VMEbus and MicroTCA technologies is likely to be much more effective in delivering advanced communications capabilities than either alone. This "coexistence" strategy will enable manufacturers and integrators to bring new comms capabilities to the embedded market with improved time-to-market, cost and flexibility, while preserving the rich set of real-time I/O capabilities of VMEbus. This convergence is the direction that Motorola is taking in its future VME development programs."

- Wendy Vittori, Corporate Vice President, General Manager
Motorola Embedded Communications Computing

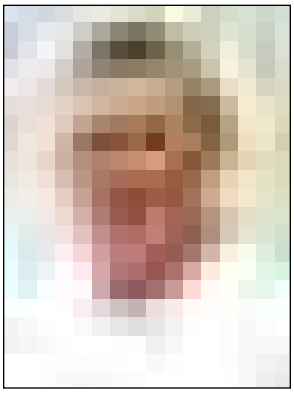
Motorola, Tempe, AZ. (602) 538-5720. [www.motorola.com/computing].



"Given the life spans of many military programs, it is undeniable that there will be VME systems still in use in 25 years time. The big question is, will anyone be designing new VME-based systems in 2031? And if they are, will they retain any of the characteristics of today's VME? Its evolution will depend on the needs and capabilities of future generations of silicon, and—even given Moore's Law—it would be foolish to try to predict what those might look like, or the uses to which they might be put. If history is our guide, and the soundest basis on which to make predictions, we can only believe that—just as it has always done—VME will continue to evolve and adapt. Whether it can change as dramatically as it may need to—and whether what remains is still VME—is a different question."

- Peter Cavill, President
Radstone Embedded Computing

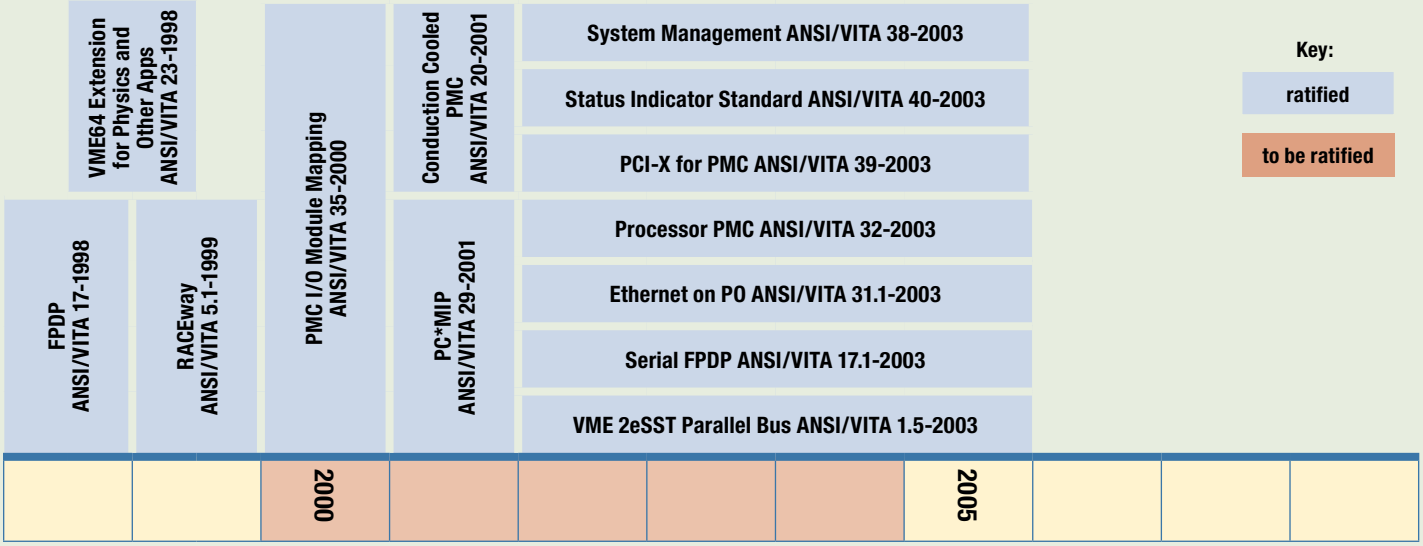
Radstone Technology, Woodcliff Lake, NJ. (201) 391-2700. [www.radstone.com].

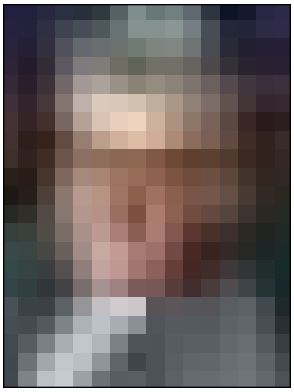


"The future of VME is still very bright. Since the VME standard was first adopted it has advanced along with technology requirements. The result is a bus standard that still meets the requirements of most industrial and military applications by providing a traditional DMA/register arbitrated access bus structure along with the latest switched technology and processing architectures."

- Clarence Peckham, CEO
SBS Technologies

SBS Technologies, Albuquerque, NM. (505) 875-0600. [www.sbs.com].





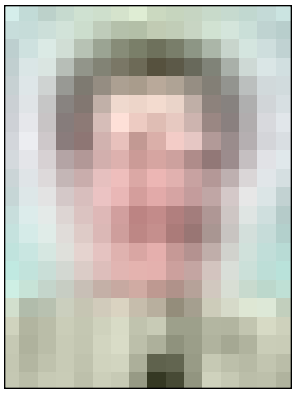
"The VME ecosystem and industry has been successfully growing over the last twenty-five years. VME standards, and the products built to those standards, have demonstrated their ability to perfectly serve the military and aerospace market, especially as those industries' needs have evolved. VME64x and 2eSST remain upwardly compatible with earlier versions released in the 1980s. For that, we can thank the strong momentum and standardization process brought by VITA. In the next twenty-five years we foresee reliable growth for VME products, mainly in defense markets as products with new improvements—such as switched fabric integration—meet the needs and requirements of customers to support use in harsh environments."

- Alain Albarello, General Manager
Thales Computers

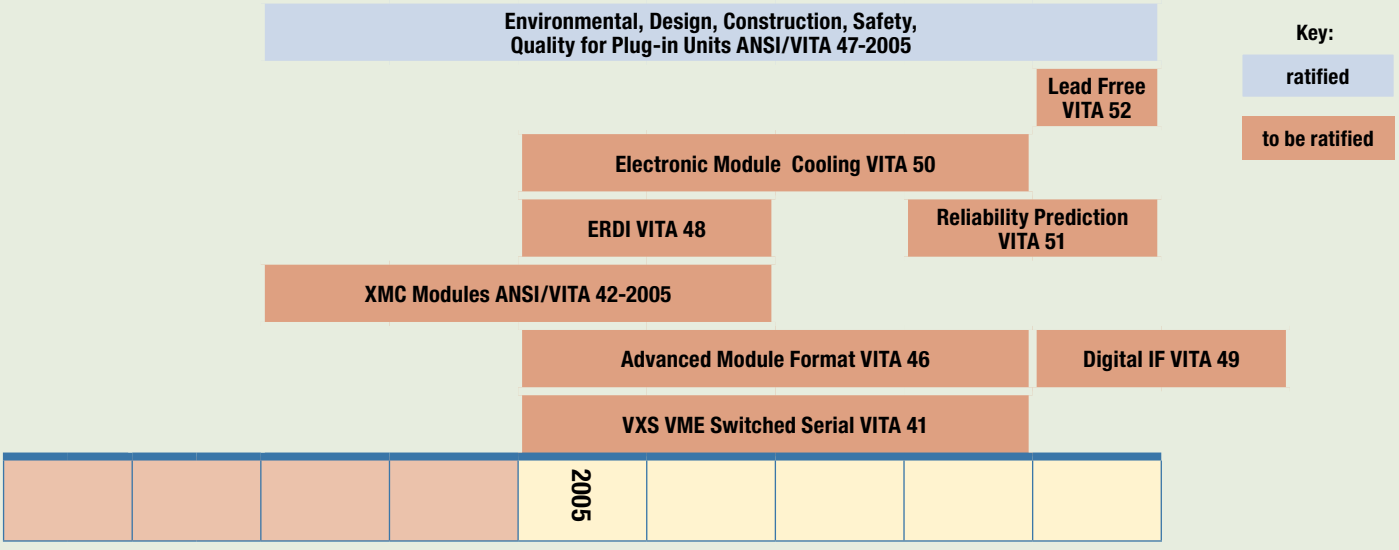
Thales Computers, Raleigh, NC. (919) 231-8000. [www.thalescomputers.com].

"We're more excited than ever about the prospects for VME, with new switched fabric specifications and more robust packaging profiles for military and aerospace applications. Themis has been hard at work making switched computing server architectures as maintainable and resilient as VME. We've been successful in that regard, and now, thanks to VITA 41 and VITA 46, we are able to make those distributed systems interoperate with VME edge devices, on a switched InfiniBand fabric. We've also crafted solutions to manage extended, heterogeneous computing grids, including VME nodes, storage and switching, in real time. These kinds of architectural and product breakthroughs position VME and companies involved in VME to, not just survive, but to thrive, well into the next quarter century."

- Bill Kehret, President
Themis Computer



Themis Computer, Fremont, CA. (510) 252-0870. [www.themis.com].



DO-178B and the Common Criteria: Future Security Levels

Although there are similarities between the airborne safety-critical requirements in RTCA/DO-178B and the Common Criteria, ISO 14508, compliance with the higher levels of security in the Common Criteria demands meeting additional security requirements.

Joe Wlad, Director, Product Management
LynuxWorks

Compliance with safety-critical requirements for software has become the foundation upon which compliance with security requirements is based. Development and certification of software for airborne safety-critical applications is typically done following a guidance document called RTCA/DO-178B. Parallels exist between compliance with RTCA/DO-178B and information technology (IT) security requirements defined in ISO 14508.

More commonly known as the Common Criteria, ISO 14508 defines functional and assurance requirements for security in IT products. Compliance with RTCA/DO-178B provides a basis for meeting both medium and high assurance requirements of the Common Criteria. To fully understand the parallels between these two standards, it is useful to explore each standard independently.

The RTCA/DO-178B Guidance Document

RTCA/DO-178B, commonly known as DO-178B, is a process-oriented document used for the development of safety-critical software. It describes a planning process, a development process, a verification process, a configuration management process, a quality assurance process and a certification liaison process.

The objectives of DO-178B are mapped to these processes. The development process uses a set of objectives for requirements, design, and coding and integration. The verification process contains objectives to review requirements, design and code as well as to produce test cases and perform structural coverage analysis. These engineering-related processes are accompanied by specific objectives for configuration management and software quality assurance. The number of these objectives depends on the software's role in system safety: the higher the level, the more objectives are required.

For example, software that controls an aircraft automatic pilot in landing an airplane has a critical role in the safety of the aircraft, whereas software that controls a passenger entertainment unit has no impact on the aircraft's safety. Obviously, failure of the software controlling the entertainment system will have only a minor effect on aircraft operation, possibly altering crew workload slightly. In contrast, a software failure of the autopilot could have a catastrophic outcome, potentially leading to the loss of life.

For this reason, DO-178B prescribes five levels of software criticality. Each level relates to the failure condition that could result from a latent software defect. Typically, a system safety assessment is done to

Software Level	DO-178B Objectives	Failure Condition
Level A	66	Catastrophic
Level B	65	Hazardous/Severe
Level C	57	Major
Level D	28	Minor
Level E	0	No Effect

Table 1
DO-178B prescribes five levels of software criticality, each associated with a specific aircraft failure condition that could result from a latent software defect. Level A is defined as the most safety-critical software level and Level E is defined as the least safety-critical software level.

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Defining Rugged

Common Criteria Evaluation Assurance Level	Process Rigor Required for Development of an IT Product
EAL 1	Functionally tested
EAL 2	Structurally tested
EAL 3	Methodically tested and checked
EAL 4	Methodically designed, tested and reviewed
EAL 5	Semi-formally designed and tested
EAL 6	Semi-formally verified, designed and tested
EAL 7	Formally verified, designed and tested

Table 2

The Common Criteria standard, ISO 14508, is used to evaluate security software via seven evaluation assurance levels (EAL 1-7). These indicate the process rigor associated with the development of an IT product, increasing from EAL 1 to EAL 7.

determine the required software level in a given application. Level A is defined as the most safety-critical software level and Level E is defined as the least safety-critical software level (Table 1).

Most of the DO-178B process objectives are similar to the objectives found in the Common Criteria.

The Common Criteria

The Common Criteria, ISO 14508, comprise an international standard that defines IT security requirements. This standard draws some of its heritage from the Trusted Computer System Evaluation Criteria, the so-called "Orange Book." The Common Criteria define two classes of security requirements: functional and assurance. The objectives of these two classes vary depending upon the security classification level.

Security functional requirements include audit, communications, cryptography, data protection, authentication, security management, privacy, protection of TOEs, resource utilization, TOE access and trusted paths.

They focus on what the IT product is supposed to do in order to meet security objectives. This implementation-independent method of identifying security functionality provides a common basis for evaluating the security capabilities of software products, including operating systems. Other federal standards requiring compliance with certain classes of functional requirements, such as cryptography or communications, may come into play.

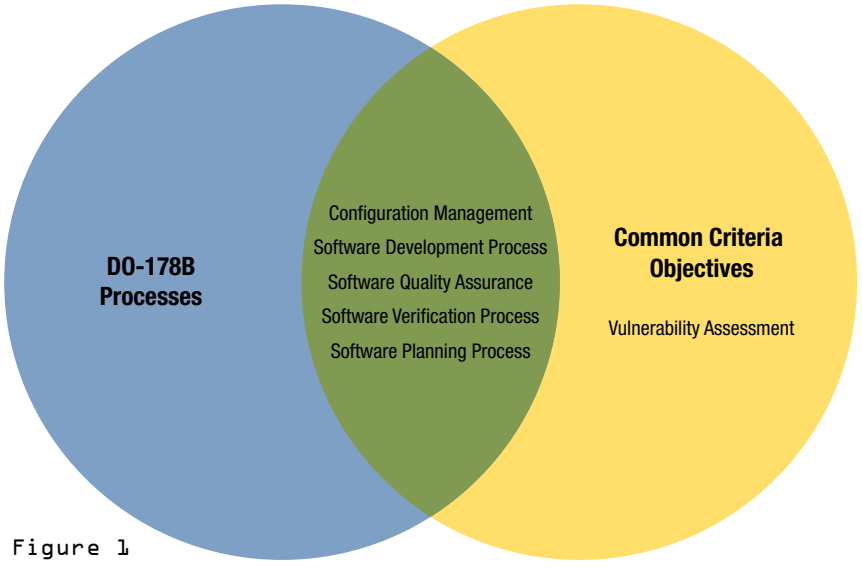

Figure 1

The DO-178B life cycle processes overlap, to some extent, with those found in the Common Criteria. In some areas, additional effort may be required to satisfy DO-178B requirements.

Security assurance requirements define the following classes of assurance processes for a software product. They include configuration, management, maintenance of assurance, development, life cycle support, tests, delivery & operation, protection profile evaluation, guidance documents, security target evaluation and vulnerability assessment.

These classes of security assurance processes indicate the software development methodology and processes required to ensure an appropriate level of rigor for a product's security level. It is these classes of processes that have commonality with DO-178B processes. Before examining this commonality, it is useful to discuss other Common Criteria terminology.

The definition of specific security functional and assurance requirements is done through the "Protection Profile" and "Security Target" documents. The Protection Profile is an implementation-independent definition of the security functionality and assurance requirements for a particular category of products. The Security Target is an implementation-specific document for a Target of Evaluation (TOE) that claims support for one or more protection profiles and forms the basis for evaluation of the software on the Security Target.

There are several protection profiles that have currently been defined for embedded operating systems. The four main profiles are the protection profile for single-level operating systems in environments requiring medium robustness; the protection profile for multi-level operating systems in environments requiring medium robustness; the partitioning kernel protection profile; and the separation kernel protection profile.

The evaluation of security software through the Common Criteria standard defines seven evaluation assurance levels (EAL 1-7) that indicate the process rigor

associated with the development of an IT product (Table 2).

The level of assurance rigor increases from EAL 1, the lowest, to EAL 7, the highest. Assurance to EAL 7 involves formal verification of the software product using mathematical models and theorem proving.

Finally, the software product developed according to a specific protection profile must be certified to a specific EAL level by a U.S. government-approved Common Criteria Testing Lab (CCTL).

Commonality Between the Common Criteria and RTCA/DO-178B

The Common Criteria view security certification of hardware and software monolithically, whereas DO-178B focuses on software verification independent of hardware platforms. Moreover, compliance with security requirements in the Common Criteria may be vastly different for applications at the same level of security.

This is because security, by its very nature, is closely linked to the design of the product. In contrast, compliance with a specific level of DO-178B is generally the same for all applications regardless of hardware platform, although additional effort is naturally required for larger applications. However, there are common threads between DO-178B objectives and the Common Criteria, to the point where use of DO-178B processes are a natural foundation for compliance with some security assurance requirements (Figure 1).

The common areas are configuration management, quality assurance, development and, to some extent, planning. Areas where additional effort may be required to satisfy DO-178B requirements include delivery and operation, guidance documents and vulnerability assessment. DO-178B does not require a vulnerability assessment, per se, for software. This is usually included in an overall system safety assessment. An updated version of DO-178, DO-178C, will likely require a vulnerability assessment for software.

Since compliance with the Common Criteria security objectives forces a look at both hardware and software, use of DO-178B processes for software can help with meeting the Common Criteria objectives. Augmentation of these software life cycle processes with hardware-specific objectives targeted toward the Common Criteria can help organizations avoid expensive, time-consuming retraining efforts dedicated to the Common Criteria objectives. Conventional wisdom states that compliance with DO-178B, Level A equates roughly to between Common Criteria EAL 4 and 5.

Compliance with higher levels of assurance (EAL 5-7) in the Common Criteria requires specialized resources that are familiar with formal methods of evaluation. Here again, the DO-178B objectives can serve as a foundation for meeting these higher levels of security. ■■

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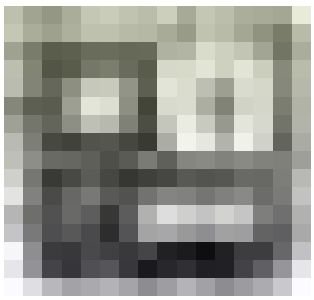

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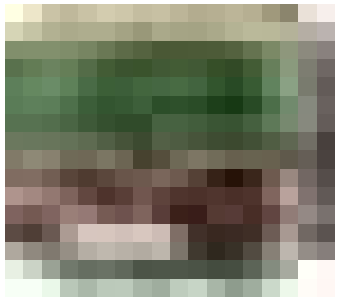

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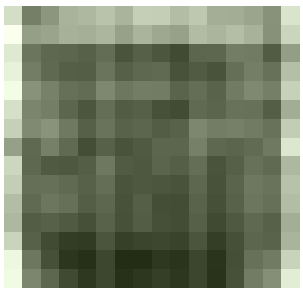

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Bus	AT Expansion Bus				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI Universal Expansion Bus	✓	✓	✓		✓		✓		✓		✓		✓	✓		
	PCI Bus Masters	4	4	4		4		4		4		4		4	4		
	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9									
CPU and BIOS	CPU Max Clock Rate (MHz)	1400	1100	1000	650	650	650	650	1000	1000	1000	1000	333	333	333	100	100
	L2 Cache	2MB	2MB	512k	256k	256k	256k	256k	64k	64k	64k	64k	16k	16k	16k	16k	16k
	Intel SpeedStep® Technology	✓	✓														
	ACPI Power Mgmt	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0					
	Max Onboard DRAM (MB)	512	512	512	512	512	512	512	512	512	512	512	256	256	256	32	32
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Quick Boot Option Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Fail Safe Boot ROM				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	IDE and Floppy Controllers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
	SSD Sockets, 32 DIP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1
	Audio	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	TFT Panel TTL or LVDS	✓	✓	✓			✓	✓			✓	✓	✓	✓			
	SVGA Interface	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
I/O	RS-232/422/485 Ports	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	USB 2.0 Ports	2	2	2													
	USB Ports				2	2	2	2	2	2	2	2	2	2	2		
	10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	ECP Parallel Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
	aDIO™(Advanced Digital I/O)	18	18	18	18	18	18	18	18	18	18	18	18	18	27		
	multiPort™(aDIO, ECP, FDC)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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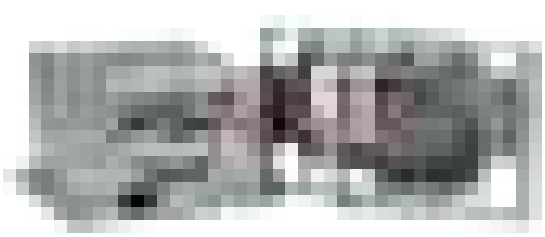

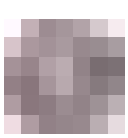

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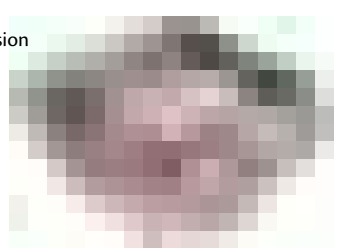

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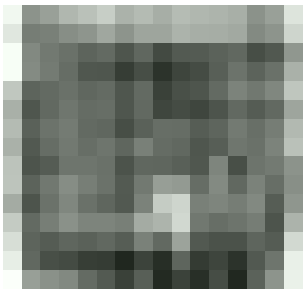

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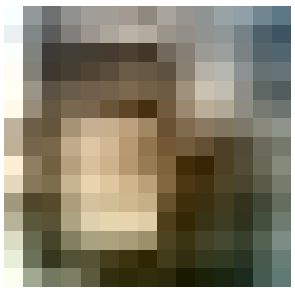

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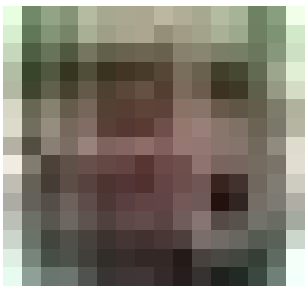

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Bus	AT Expansion Bus	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI Expansion Bus Master			✓	✓			✓	✓						✓
	McBSP™ Serial Ports		✓	✓	✓			✓	✓						
Analog Input	Single-Ended Inputs	16	16	16	16	16	16	16	16						
	Differential Inputs	8	8	8	8	8	8	8	8						
	Max Throughput (kHz)	500	1250	1250	1250	500	100	1250	100						
	Max Resolution (bits)	12	12	12	12	12	16	12	16						
	Input Ranges/Gains	3/4	3/7	3/7	3/7	3/4	1/4	3/6	1/4						
	Autonomous SmartCal™	✓	✓	✓	✓										
	Data Marker Inputs	3	3	3	3	3		3							
Conversions	Channel-Gain Table	8k	8k	8k	8k	8k	8k	8k	8k						
	Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓	✓	✓						
	A/D FIFO Buffer	8k	8k	8k	8k	8k	8k	8k	8k						
	Sample Counter	✓	✓	✓	✓	✓	✓	✓	✓						
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓
	SyncBus		✓	✓	✓			✓	✓						
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	16	16	48	32	64	32	48
	Bit Programmable I/O	8	8	8	8	8	8	8	8	8	24				48
	Advanced Interrupts	2	2	2	2	2	2	2	2	2	2				2
	Input FIFO Buffer	8k	8k	8k	8k	8k	8k	8k	8k						2M
	Opto-Isolated Inputs											16	48	16	
	Opto-Isolated Outputs											16	16		
	User Timer/Counters	2	3	3	3	2	2	3	2	3	3				10
	External Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓
	Relay Outputs													16	
Analog Out	Analog Outputs	2	2	2	2	2	2	2	2	4					
	Max Throughput (kHz)	200	200	200	200	200	100	200	100	200					
	Resolution (bits)	12	12	12	12	12	16	12	16	12					
	Output Ranges	4	4	4	4	3	1	4	1	4					
	D/A FIFO Buffer		8k	8k	8k			8k		8k					

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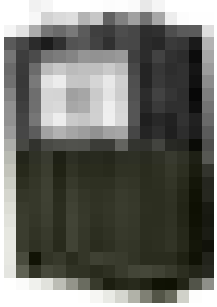

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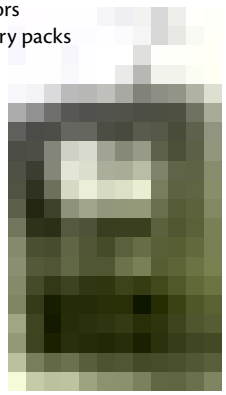

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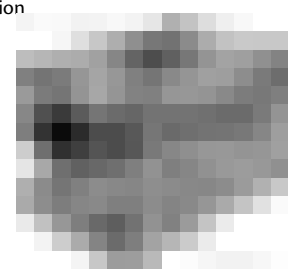

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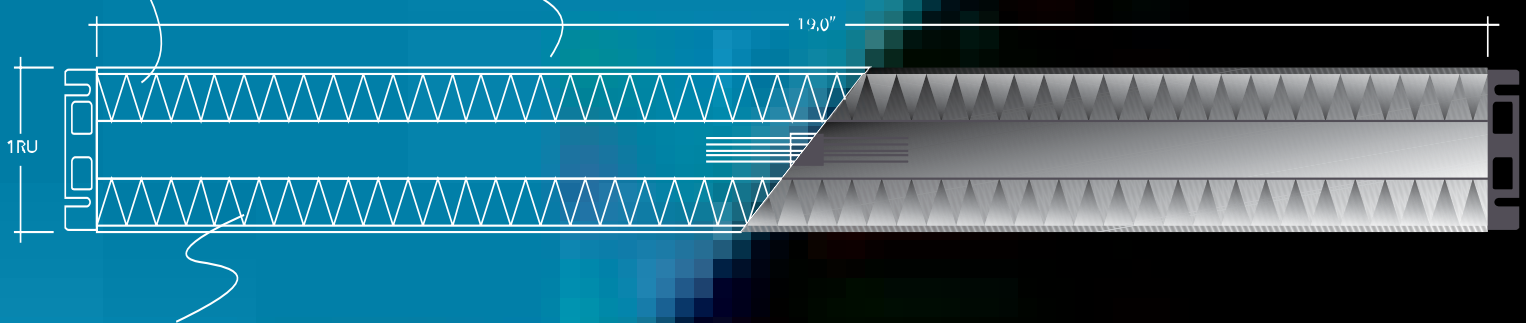

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Leveraging Java to Achieve Component Reusability in Safety-Critical Systems

New DO-178C guidelines will support modular certification of safety-critical software systems. A proposed standard for safety-critical development using Java provides encapsulation features that are critical to this effort.

Kelvin Nilsen, Chief Technology Officer
Aonix

The existing DO-178B guidelines for certification of safety-critical avionics software require that all certification evidence applies to complete systems rather than to the individual components that comprise the systems. Although safety-critical software may be composed of many independently developed components, the certification effort, which represents the large majority of development costs, must deal with all of the software as an integrated system.

Current safety-critical guidelines, originally published in 1992, do not allow the composition of certification proofs for independent components into a larger proof for the integrated system. This constraint discourages the use of modern software development practices for the development and maintenance of certification proofs. Work is therefore under way to establish new guidelines to support modular certification of safety-critical software systems. Critical to the success of this approach is the ability to isolate the semantic behavior of independent components.

Updating DO-178B

The effort to update the DO-178B safety certification guidelines began with the formation of RTCA Special Committee 205, Software Considerations in Aeronautical Systems, in March 2005. The new guidance document will be identified as DO-178C. Work on this new standard represents a collaboration between the European Organisation for Civil Aviation Equipment (EUROCAE) and the Radio Technical Commission for Aeronautics (RTCA).

Among the topics to be addressed in the new guidelines are recommendations regarding the use of object-oriented technologies in safety-critical systems. The results of a preliminary study on this topic were published in October 2004 in the "Handbook for Object Oriented Technology in Aviation (OOTiA)."

The use of object-oriented technologies in safety-critical systems is motivated by many of the same factors that apply to more traditional software domains: improved software reuse, more flexible software architectures and reduced soft-

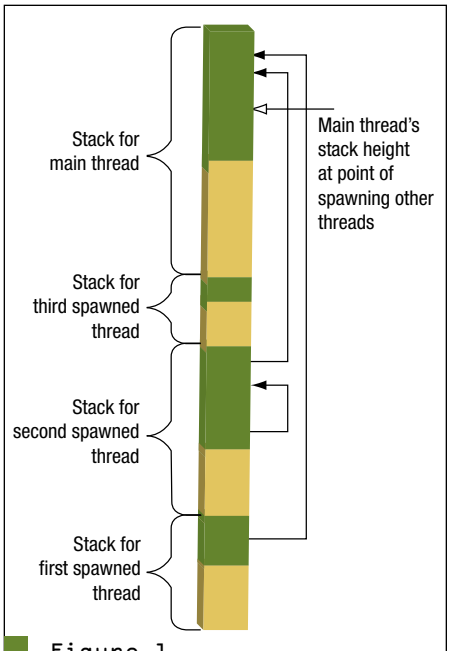

Figure 1

Organization of temporary memory within a typical safety-critical Java application after the main thread has spawned three child threads. Shading marks the portion of each run-time stack currently in use. Since inner-nested objects may refer to outer-nested scopes, the pointer relationships shown with solid-filled arrowheads are legal.

```
@StaticAnalyzable public synchronized void handleAsyncEvent() {
   byte b;

   if (status.readByte() == RcvReady) {
      b = data_xfer.readByte();
      if (write_buffer_count < BUFFER_LENGTH)
         shared_buffers[write_buffer_index][write_buffer_count++] = b;
      // else, buffer overflow is ignored

      if (reader_waiting)
         this.notify();
   }
   control.writeByte(ResetPort);
}
```

Figure 2

The safety-critical Java profile provides standard annotations, such as the @StaticAnalyzable annotation shown here, so programmers can constrain the behavior of particular methods. In sample source code for a hardware interrupt handler, the method is marked with the @StaticAnalyzable annotation to indicate that the static analyzer must be able to automatically derive worst-case CPU time and memory allocation requirements.

ware maintenance costs. Since the greatest costs in deployment of safety-critical software are associated with the certification processes, it is particularly important to support modular composition of safety certification artifacts.

Although the current DO-178B guidelines do not specifically support modular composition of software certification artifacts, some companies already exploit modular certification techniques in certain safety-critical systems. One of the expectations regarding the DO-178C guidelines is that they will formalize the objectives for such approaches.

Modular Composition of Hard Real-Time Components

There are good reasons why the DO-178B guidelines require that each safety-critical system must be certified as a complete unit. The traceability and testing requirements detailed in these guidelines require that the system be scrutinized as a complete application. There are currently no provisions for modular composition of independent software component certification artifacts.

There are several reasons why the DO-178B guidelines do not endorse modular certification of safety-critical components. One reason is the fact that, at the time these guidelines were developed, the industry had not yet mastered tech-

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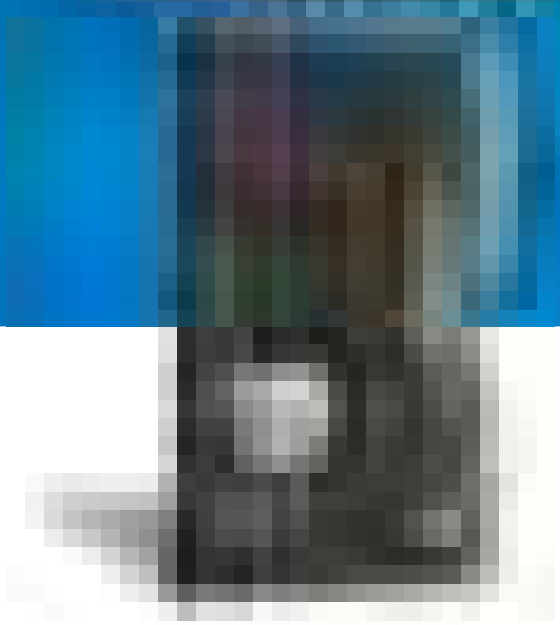
- ATI M26 Mobility Radeon graphics on PCI Express



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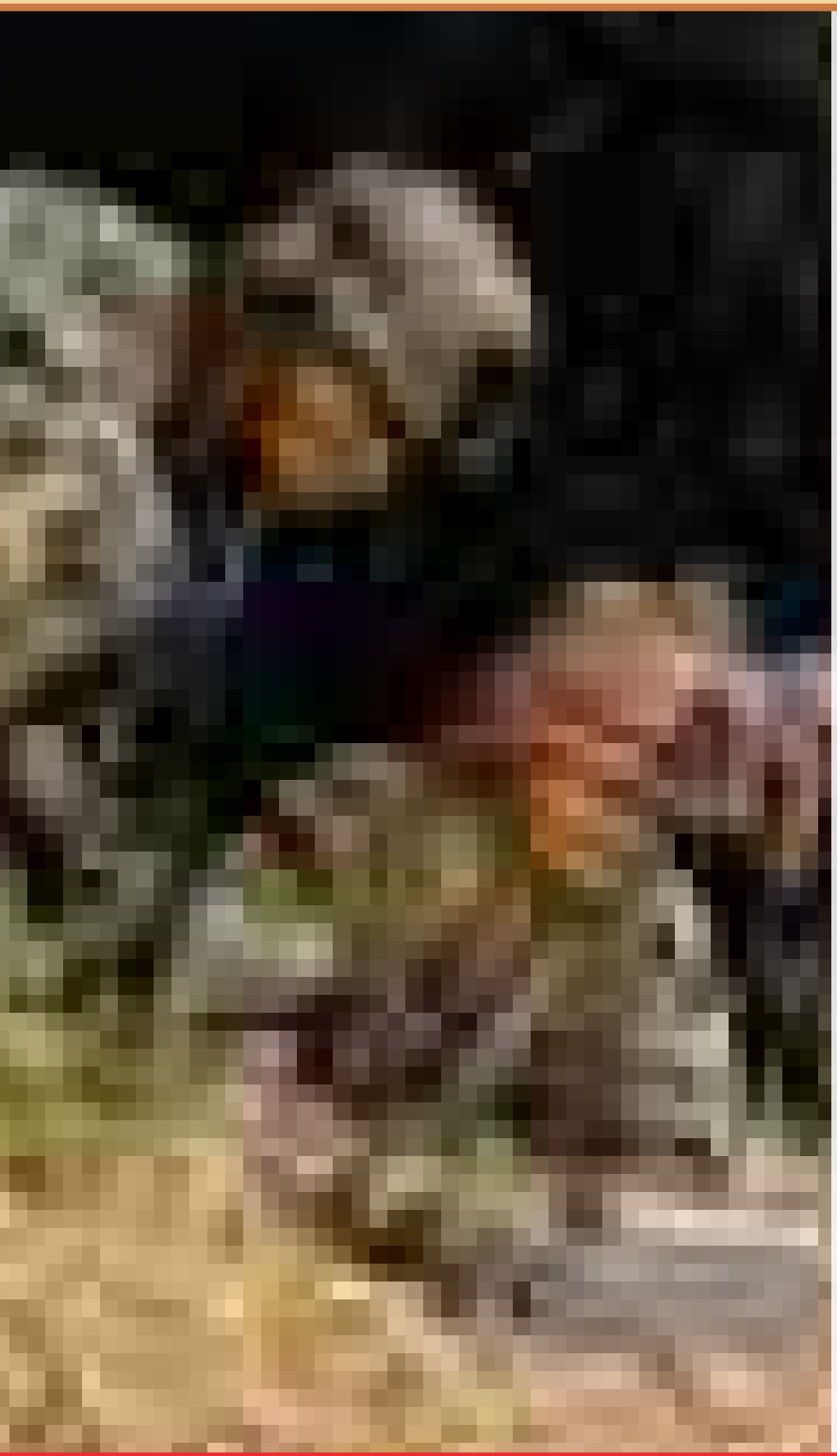

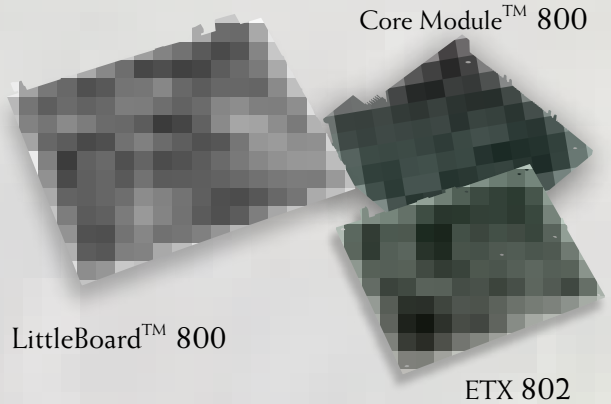

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niques for modular composition of hard real-time software components.

In general, it has not been feasible to assemble a hard real-time system out of independently developed and verified hard real-time components. This is because the validity of each independent component cannot be demonstrated in isolation from its context. Whether or not the component will reliably satisfy its real-time constraints will depend on how much CPU time and unfragmented memory is available to the component when it needs to run. The ability to answer these questions generally depends on a complete analysis of the contention for shared memory and CPU time resources that will exist at run time.

Motivated by the drive toward ever increasing size and complexity of safety-critical software, work on a safety-critical specification for Java has already begun. The goals of this effort are not only to match the capabilities offered currently by C, C++ and Ada, but also to significantly improve upon the use of those languages for development of safety-critical systems. In particular, there is a requirement to enable modular composition of hard real-time software components, a requirement which has not previously been satisfied.

This modular composition requires that the validity of each module's functional and real-time behavior depends entirely on implementation details that are safely encapsulated within the module's private representation. Encapsulation describes the concept that the details associated with implementation of a particular module are hidden within the module's implementation and all interference with these private details by other modules is prohibited.

Several enabling technologies have been proposed in a draft specification for safety-critical Java development. These technologies make possible reliable automatic integration of independently developed, portable, hard, real-time software components. They are a portable, real-time platform; safe stack allocation of objects; atomic synchronization locks; and static analysis of CPU time and memory requirements.

A Portable, Real-Time Platform

The draft safety-critical development guidelines establish a well-defined subset of Java Standard Edition (SE) and Real-Time Specification for Java (RTSJ) libraries. Although the Java platform is portable with respect to functional behavior, Java SE does not provide portability with respect to real-time issues. For example, the amount of memory required to represent a particular data structure may vary significantly from one Java implementation to the next. Another example is the fact that the scheduling of threads is highly platform-dependent. To address these issues, the draft safety-critical Java guidelines carefully constrain the precise real-time semantics and resource requirements of the Java SE and RTSJ library subsets.

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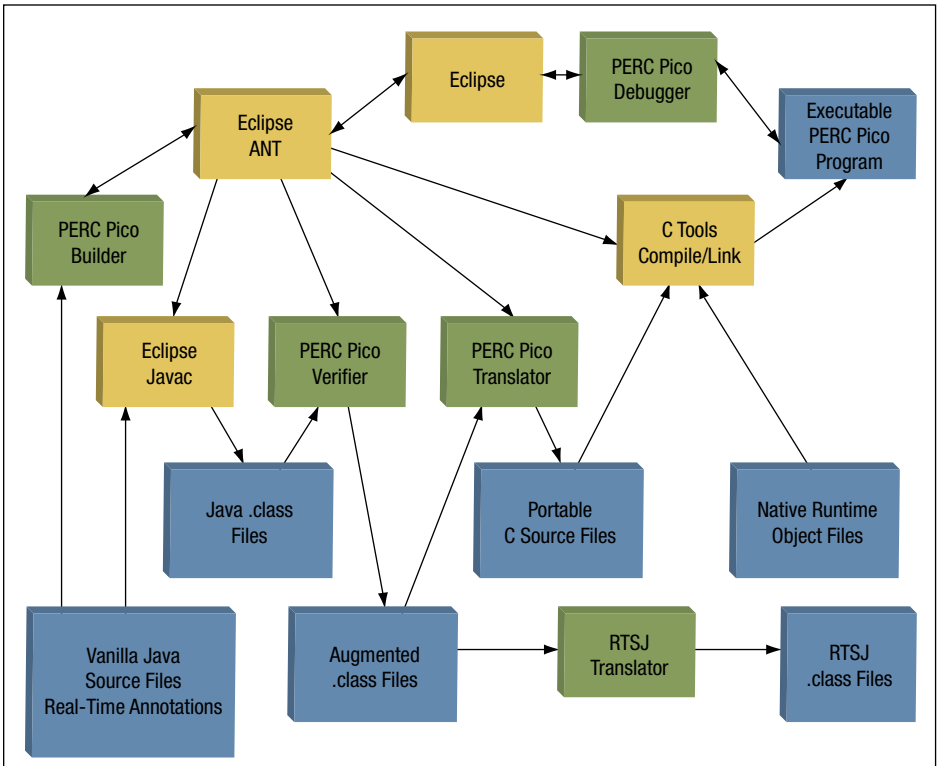

Figure 3

To assure reliable operation, developers of hard real-time software must carefully analyze memory and CPU time resources required for operation of real-time tasks. The hard real-time development environment in which this analysis is performed combines real-time byte code verification and static analysis tools with traditional Java development tools.

This situation is quite different from the typical approach of a C or C++ developer. Since these languages were not designed for multi-threaded environments, the existing standards do not sufficiently constrain the sharing of information between threads. If a particular thread modifies a shared variable, even a variable that is defined as volatile, propagation of the new value to other threads that are monitoring the same variable is highly non-portable.

C and C++ programmers must therefore understand the compilation and optimization code generation models, the underlying architecture's cache coherency model and the underlying operating system's thread scheduling semantics. Often, the information required to develop reliable code is not well documented, so programmers must spend time and effort doing trial-and-error testing in order to fully understand the target platform. When software is moved to a different CPU, compiler or RTOS, extensive code review and re-testing is required.

The RTSJ exhibits some of these same difficulties. Many RTSJ capabilities are optional, and the semantics of certain other features such as precisely when to trigger execution of a cost- or deadline-overrun handler are imprecisely specified. The safety-critical RTSJ subset specifically excludes capabilities that are difficult to define and implement in a portable way. It also avoids complex and costly features that are less relevant to developers of safety-critical and hard real-time systems.

Safe Stack Allocation of Objects

Management of temporary scratch-pad memory during the execution of hard, real-time safety-critical threads must be deterministic and reliable. The C malloc()/free() and C++ new/delete() services are vulnerable to memory frag-

mentation. Allocation of RTSJ Scoped-Memory contexts are also subject to memory fragmentation. Thus, these allocations should not be performed in memory-limited, safety-critical systems.

Stack-based object allocation in C and C++ avoids fragmentation, but introduces the risk of dangling pointers. The draft safety-critical Java guidelines support the best of both worlds by using the byte-code verifier to assure at compile time that use of stack-allocated objects does not result in dangling pointers (Figure 1).

Atomic Synchronization Locks

Atomic synchronization by priority ceiling emulation is another important abstraction supported under the draft safety-critical Java guidelines. Programmers make use of a special syntax to identify objects that use atomic priority ceiling emulation for coordinating shared access between multiple threads. For each of these objects, the safety-critical byte-code verifier assures that the component does not perform any blocking operation while a given thread holds the object's atomic lock. With this byte-code enforcement in place, the implementation of atomic locks is highly efficient and the worst-case blocking time to access an atomic lock may be easily analyzed.

In particular, if a given thread is able to reach the point of entry to that lock, it is guaranteed that no other thread owns the lock. Thus, the blocking time is always zero. This important abstraction is recommended for all resource sharing among hard real-time safety-critical threads. It can only be implemented reliably through coordination between static analysis tools and run-time services. This coordination is provided within the safety-critical Java profile. It is not available in C, C++, Java SE or the RTSJ.

Static Analysis of CPU Time, Memory Requirements

In order to assure reliable operation, developers of hard real-time software must carefully analyze the memory and CPU time resources required for operation of real-time tasks. Standard C, C++ and Java implementations provide no analysis support. The safety-critical Java profile provides standard annotations (Figure 2) to allow programmers to constrain the behavior of particular methods. The safety-critical byte-code verifier enforces that the code conforms to these style guidelines and a separate static analysis tool determines the resource needs for each targeted platform.

By establishing a tight integration of static analysis development tools, standardized hard real-time libraries and a portable run-time environment (Figure 3), a draft safety-critical specification for Java offers a significant improvement upon the state of the art in the development and maintenance of safety-critical software and certification artifacts. ■■

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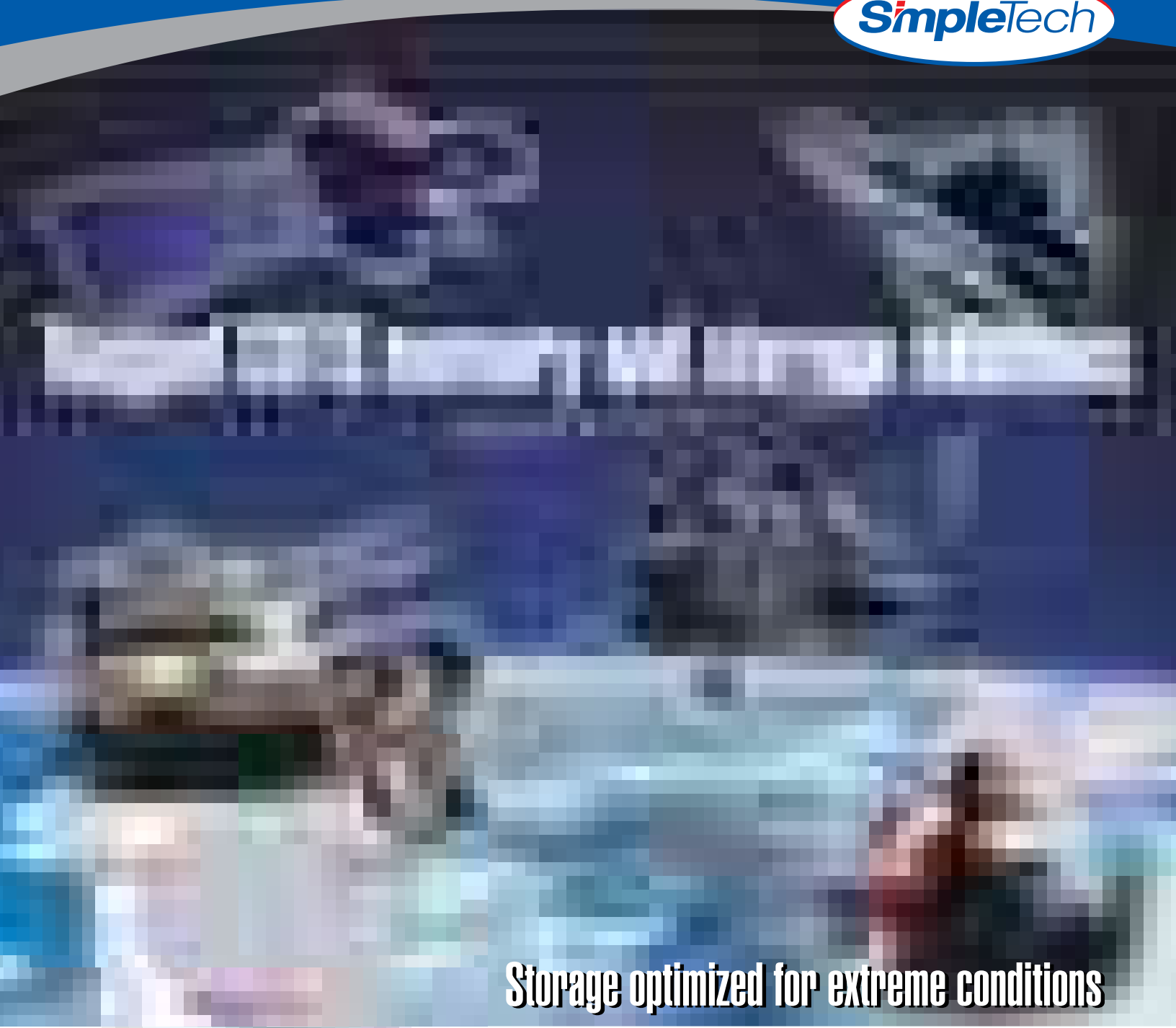

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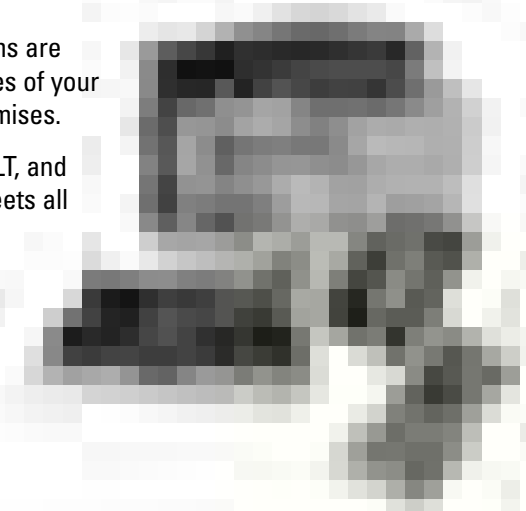

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Special Section

MEECC Show Preview

MEECC 2006 Show Brings it All Together

Building on the resounding success of its inaugural event last year, the Military Embedded Electronics and Computing Conference (MEECC) show promises to again satisfy attendees hunger for critical information revolving around the design, development, deployment and support of electronics and computers for the military. MEECC will be held at the Hyatt Regency Long Beach in Long Beach, California on May 16 and 17. Sponsored by VITA, the MEECC focuses on the unique needs of both embedded users and suppliers.

In keeping with the technology theme central to MEECC, the conference organizers have tasked Dr. Robert F. Leheny (Figure 1), Deputy Director of DARPA, as the Keynote Speaker. Since joining DARPA sixteen years ago, Leheny's program interests have focused mainly on advanced areas such as the application of photonics, microelectronics and MEMS technologies to communication and RF systems and related materials and device technologies for information processing systems applications.

Figure 1

Dr. Robert F. Leheny, Deputy Director of DARPA, will be the Keynote Speaker at this year's MEECC show, May 16 – 17 in Long Beach, CA.

Tuesday May 16: Main Session – Featured Speakers and Panels

Keynote Speaker	**Dr. Robert F. Leheny,** Deputy Director, Defense Advanced Research Projects Agency (DARPA)
Principal Speaker	**Dennis Carlson,** Carlson Technologies *"Line Replaceable Units/Modules in Military and Avionics Programs."*
Users Panel	Key persons from the military and prime contractors weigh in to discuss today's challenges and tomorrow's opportunities for embedded electronics in the Military.
Industry Advocates Panel	Senior persons from leading military industry organizations—such as MITRE and the Open System Joint Task Force—lend their unique perspectives on embedded electronics applied to military applications.
Suppliers Panel	Leaders from different market segments supplying embedded products for use by the military.

Wednesday May 17: Conference Tracks

Track 1: CoolCON	In its fourth year, CoolCON, once a stand-alone conference, is now an integral part of MEECC. The CoolCON track on Wednesday focuses on the latest aspects of cooling technology so critical in the deployment of today's high-performance electronic systems.
Track 2: Mil & Avionic Programs Update	Updates/overviews on eight key military programs and their requirements for embedded electronics, presented by top military industry editors.
Track 3 – AM: New Embedded Products	The latest embedded electronics and embedded computer products first introduced to the market during MEECC.
Track 3 – PM: RoHS – How To …	Critical information on how to deal with the Reduction of Hazardous Substances (RoHS) initiative, and the complex issues it involves for the military.

As Program Chairman of the MEECC, Pete Yeatman, has brought together a unique mix of panels, speakers and technology tracks to showcase issues—both broad and specific—concerning embedded electronics and embedded computing as they apply to military applications. New this year is a track focused on dealing with the Reduction of Hazardous Substances (RoHS) initiative and all the complex issues it involves for the military. This year's "Mil & Avionic Programs Update" track has been expanded to include updates/overviews on eight key military programs—including Future Combat Systems, DD(X), J-STARS, JTRS, WIN-T and others—presented by top military industry editors and program managers. The tables below summarize the panels and tracks to be presented at the show. ■■

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PXI and VXI Put Military Systems to the Test

PXI and VXI boards have become entrenched as solutions for testing complex military system designs. Meanwhile, the Ethernet-based LXI standard is paving a path to the future.

Jeff Child

No complex military embedded systems, and aircraft in particular, can get through its development phase without bringing to bear heavy duty test and instrumentation equipment. Gone now are the days when such gear was developed from scratch, using custom-designed test systems. Today, test systems can be pieced together around standard and embedded computer systems. Feeding such needs, two specifications have evolved—PXI and VXI—and each boasts an established ecosystem of board products and options.

PXI (PCI eXtensions for Instrumentation), an open specification from the PXI Systems Alliance, defines a rugged, CompactPCI-based platform optimized for test, measurement and control. PXI products are compatible with the CompactPCI form-factor and bus architecture. Currently, more than 68 companies worldwide are members of the PXI Systems Alliance, and today more than 1,150 PXI products are available.

In an example of PXI used for a military design, BAE Systems tapped TBG Solutions to craft a new test suite to efficiently characterize RF cables within major units of the Eurofighter Typhoon aircraft (Figure 1). Using the PXI/CompactPCI platform and National Instruments LabVIEW software, they designed a simplified test system that increases productivity by facilitating more flexible testing.

PXI for RF Cable Tests

BAE needed a new test suite for more efficient RF cable characterization within major units of the aircraft. Every cable has a different operating frequency, cable length and routing characteristics, and each of these characteristics impacts performance. That originally required specialist engineers to conduct testing, but this was expensive and it limited testing to a small window of time. Using a combination of PXI and CompactPCI hardware, a system was developed to automate the test equipment setup routines and test each product fully, including individually testing each cable as required.

PXI's older cousin, the VXIbus, was developed by enhancing the VME bus standard to better accommodate instruments. VXI extends VME by adding additional power supply voltages, analog and triggering buses. It also features complete power, cooling and EMC specification requirements for modules, and adds C and D-Size module sizes for larger cir-

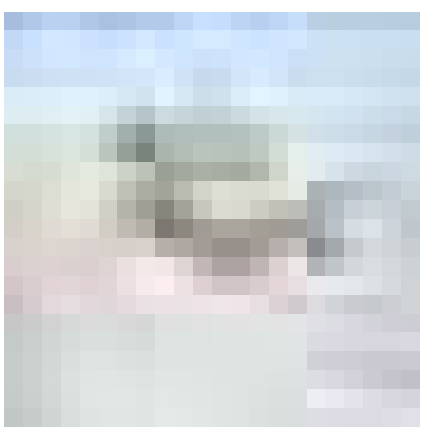

Figure 1

Using PXI- and CompactPCI-based boards, BAE Systems tapped TBG Solutions to craft a new test suite to efficiently characterize RF cables within major units of the Eurofighter Typhoon aircraft. Blending the PXI/CompactPCI platform with National Instruments LabVIEW software, they designed a simplified test system that increases productivity by facilitating more flexible testing.

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cuit layout area. VXI also adds the twist of being able to accept PXI, VME and M-Module cards.

With this many players and products in PXI and VXI, it's not practical to provide a comprehensive list of all the companies or details of their products. The product roundup on the following pages highlight twelve examples of boards—processors, I/O, instrumentation and power supplies—from twelve different companies that meet PXI or VXI specifications or both.

The natural follow-on to PXI and VXI is an emerging technology called LXI (LAN eXtensions for Instrumentation). LXI is an instrumentation platform based on industry standard Ethernet technology. In particular, military designers are hungry for synthetic instruments that feature state-of-the-art microwave performance. PXI and VXI implementations simply don't have the board space to create high-performance instruments, forcing integrators to use both card-cage and stand-alone architectures in their systems.

In February, the LXI Consortium held its fourth PlugFest event. A variety of products from Agilent Technologies, Keithley Instruments Rohde & Schwarz and Symmetricom were tested in key areas of the specification, including LAN functionality, Web interface, programming API and hardware triggering. The event was attended by 46 members of the LXI Consortium. ■■

LXI Consortium
[www.lxistandard.org].

PXI Systems Alliance
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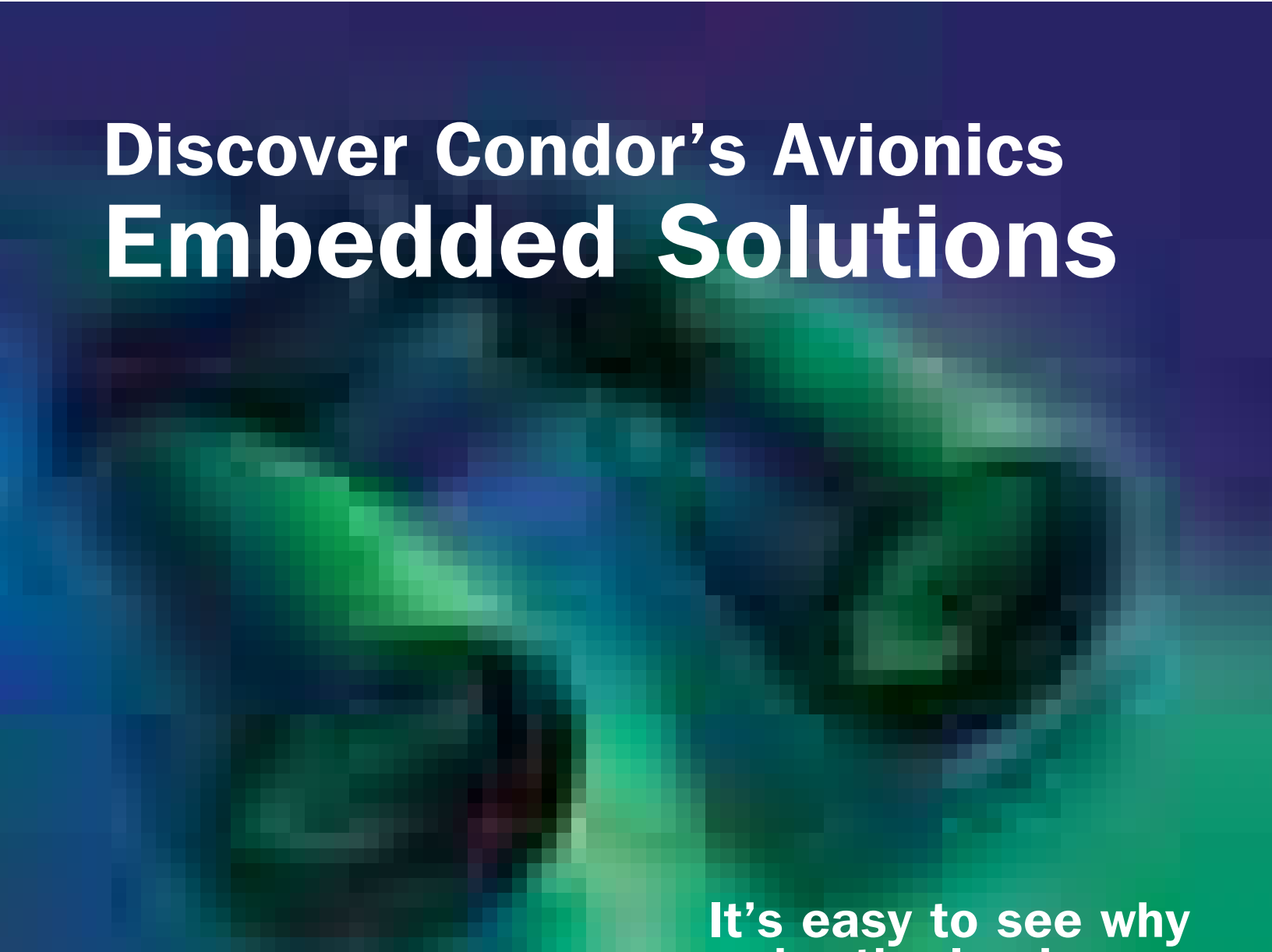

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Technology Focus:

PXI and VXI Boards Roundup

DSP, FPGA, Large Memories Team for Fast Execution

When the application requires the fast execution of demanding algorithms, often the best choice is to use the combination of a DSP and an FPGA. The DSP104 from 4DSP is a 3U PXI board comprising a 1 GHz fixed-point 64-bit TMS320C6416T DSP from Texas Instruments and a Virtex-II Pro FPGA (XC2VP30). Large memory resources are available, with up to 256 Mbytes of SDRAM

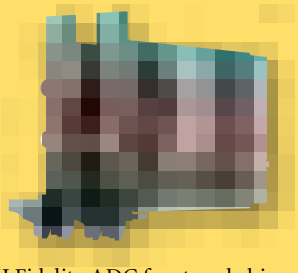
connected to both the DSP and the FPGA. Engineered for high-performance systems, the DSP104 offers a wide-input data bandwidth with two 400 Mbyte/s high-speed connectors. Parallel data protocols, such as Front Panel Data Port (FPDP), can be implemented over the 32-bit data buses connected directly to the FPGA, enabling a flexible and fast interface to boards transferring data via their front panel. Fast serial communication links are also available with up to 8 Xilinx Rocket IO at 2.5 Gbits/s each, delivering bandwidth performances exceeding most requirements. Host systems can communicate and exchange data with the DSP104 over the PXI bus.

Dedicated to executing demanding Digital Signal Processing algorithms, the DSP104 is particularly well suited for connecting to digitizer boards with large data throughputs. The Virtex-II Pro FPGA, with integrated parallel mathematical engines, processes raw information on-the-fly and performs Fast Fourier Transforms and Digital Down Conversions, allowing substantial reduction of the signal bandwidth. Off-the-shelf Intellectual Property (IP) cores for multi-channel demodulation and decomposition are also available from 4DSP. Combined on the same board with the FPGA, the 1 GHz Texas Instruments DSP device leverages the execution of complex algorithms by offering a C-programmable software platform, allowing users to reduce development times. The DSP104 3U PXI card is delivered with drivers and program examples and is priced at $4,295.

4DSP
Reno, NV.
(775) 830-2059.
[www.4dsp.com].

3U PXI Digitizers Target Fast RF and ATE Apps

Modular test architectures like PXI let designers craft synthetic instrumentation systems that can replace standard digital multimeters, oscilloscopes, power meters and frequency counters in RF and microwave test systems. Acqiris smoothes the way with a family of 10-bit, 4 Gsamples/s, 3U PXI digitizers, with input bandwidths of up to 3 GHz. The dual-channel DC152 and single-channel DC122 digitizers significantly increase data acquisition and testing rates, making the new digitizers ideal for high-speed applications such as telecommunications and semiconductor testing, where test time should be limited only by the speed limits of the device under test (DUT). The single-slot, 3U PXI/CompactPCI digitizers incorporate Acqiris' proprietary XLFidelity and JetSpeed II ADC chipsets.



The XLFidelity ADC front-end chipset integrates the signal conditioning, amplification and interleaving functions essential to high-speed data acquisition into two companion ASIC devices. The JetSpeed II chipset is designed to enhance high-speed ADC performance through the distribution of accurate timing signals, and synchronously pass the acquired data to onboard memory. The DC152, with 2 GHz of bandwidth, provides synchronous sampling of 2 Gsamples/s on both input channels with up to 256 Mpoints of optional acquisition memory; in single-channel applications this doubles to 4 GS/s and up to 512 Mpoints. The single-channel DC122 offers sampling rates of up to 4 GS/s with 512 Kpoints of standard, or 512 Mpoints of optional acquisition memory. It also offers the choice of standard or high frequency front-ends that can be selected at the time of order, tailoring the digitizer module to the user's needs. Pricing for the new 3U PXI/CompactPCI DC152/DC122 10-bit digitizers begins at $16,480.

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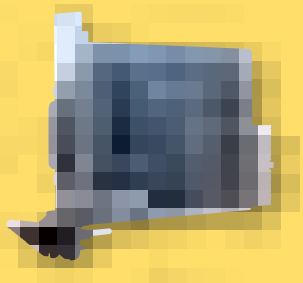
PXI IEEE 488 Interface Controller Card Does 1.5 Mbytes/s

The IEEE488.1 and IEEE488.2 interface standards have become as common as sliced bread. Linking to those technologies, ADLINK Technology, a leading provider of test and measurement products, released its first PXI IEEE 488 controller card. The PXI-3488 is



a PXI-bus GPIB card and features an easy drop-in system configuration for existing test and measurement applications. The PXI-3488 provides an interface between GPIB instruments and PXI-equipped systems that is compliant with IEEE488.1 and IEEE488.2 standards.

The PXI-3488 is PXI bus-compatible and represents ADLINK's innovations in PXI hardware design. It is suitable for most PXI platforms and provides the connectivity between PXI platforms and GPIB instruments. In addition, the PXI-3488's 1 Kbyte onboard FIFO and high-speed bus accelerated by the onboard CPLD gives it a 1.5 Mbyte/s maximum data transfer rate to satisfy high-volume data transfer requirements.

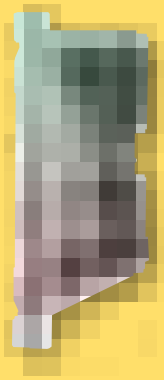
The PXI-3488 has been hardware and software verified with a wide range of products and applications. It supports popular application development environments such as VB, VC++, Delphi, LabVIEW and TestExec and features "drop-in" system configuration to be compatible with existing test and measurement applications. The PXI-3488 supports Windows 98/NT/2000/XP and its driver library is compatible with industry standard VISA and instrumentation protocols. The PXI-3488 is competitively priced at $345 and is available from stock with discounts in volume.

ADLINK Technology America
Irvine, CA.
(949) 727-2077.
[www.adlinktech.com].

1U Half-Rack LXI Card Provides Switching and Control

LXI is the next-generation, Ethernet LAN-based modular architecture standard for automated test systems managed by the LXI Consortium. LXI is catching on fast among military designers, which is not surprising considering the military's growing affection toward Ethernet.

Helping to build out the product offerings in the nascent LXI architecture, Agilent Technologies announced seven new LXI Class C instruments that are the industry's first LXI Unit (as defined by the LXI Consortium) in switching and control in a 1U, half-rack instrument form-factor.



The Agilent L4400 Series of switching and system control instruments are small, industry-standard instruments that can be placed wherever the application requires. The unit's remote capabilities and graphical Web interface reduce setup and troubleshooting time for engineers building design verification and functional test systems in the aerospace/defense, communications, medical and computer industries.

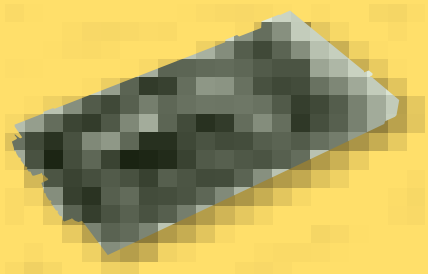
The Agilent L4400 Series instruments are high-performance instruments that allow engineers to buy only what they need and easily add to it when their application changes. The Ethernet interface allows for simple connection to the PC or to a network for access across an engineering workgroup. The fully featured graphical Web interface goes beyond the LXI standard and provides full control of the instrument through a standard Web browser. For example, engineers can use the Ethernet connection and the unit's graphical Web interface to remotely access and control the instrument from anywhere on the network. This enables engineers to monitor a test setup; open, close and scan switches; view commands that have gone across the bus; and troubleshoot an application via a standard Web browser. The Agilent L4400 Series switches and control instruments are priced between $1,506 and $2,800 and are available now.

Agilent Technologies
Palo Alto, CA.
(650) 752-5000.
[www.agilent.com].

Data Capture Systems Support up to Eight SATA Drives

Data capture and playback is essential to the military PXI users for high-performance measurement and automation. Conduant, a developer of direct-to-disk, long duration recording and playback systems, has announced the availability of products for PXI bus data capture supporting up to eight Serial ATA disk drives. The StreamStor PXI-808 real-time recorder and playback disk controller and Big River DM4 1U rackmount chassis combine to deliver 200 Mbytes/s of sustained performance, reliability and security for laboratory and bench-top instrumentation applications. Conduant's PXI disk controller provides compatibility with National Instruments' LabVIEW software and PC-based instrumentation hardware. Serial output from one StreamStor PXI-808 disk controller connected to two DM4 units will accommodate up to two Tbytes of online data storage.

Conduant's Big River Recorders provide recording and playback technology in industrial strength portable or rackmount enclosures. All systems are factory configured with a Conduant StreamStor controller, disk drives and motherboard/operating system or PCI/PXI expansion systems. When Conduant's direct-to-disk StreamStor and Big River recording technology is combined with LabVIEW and PXI, engineers can generate and

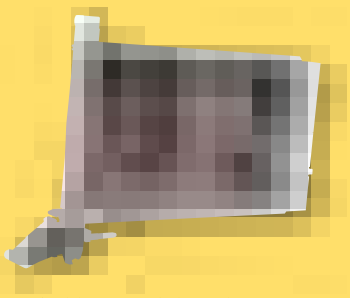


acquire complex signals for extraordinarily long time periods. With up to 2 Tbytes of memory depth, this solution opens up a new world of terabyte instrumentation for both rugged industrial and performance research applications. The StreamStor PXI-808 disk controller is now available for $7,310. The Big River DM4 rackmount chassis supporting Serial ATA drives is available for $2,860.

Conduant
Longmont, CO.
(303) 485-2721.
[www.conduant.com].

3U PXI Board Family Serves Up Digital I/O Feast

Complex automatic test requirements are far from rare in the military realm. Feeding that need, the GX5280 Series from Geotest are high-performance, cost-effective 3U PXI dynamic digital I/O boards with 32 TTL input or output channels and 32 LVDS input or output channels. The GX5280 Series offers 512 Mbytes of onboard memory and supports test rates up to 200 MHz. The single board design supports both master and slave functionality without



the use of add-on modules. The GX5280 Series supports selectable I/O levels of 1.5V, 1.8V, 2.5V, 3.3V, or 5V (TTL, LVTTL, CMOS, LVCMOS). In addition, the GX5282 and GX5283 also support 32 differential channels for LVDS, M-LVDS, or LVDM logic families.

The TTL/LVTTL interface utilizes a programmable voltage source that sets the output logic levels from 1.4V to 3.6V. Programmable thresholds of 1.5V, 1.8V, 2.5V or 3.3V (5V compatible) are supported for input signals. Recommended operating input voltage range is from 0V to 5.5V. The GX5282 and GX5283 can operate as stand-alone cards or with up to seven additional slave boards, providing a total of 256 synchronous channels.

The GX5281 provides 128 Mbytes of total memory with 32 Mbits per channel while the GX5282 provides 256 Mbytes of total memory with 64 Mbits per channel. The GX5283 has 512 Mbytes of total memory. Programmable I/O width allows trading vector width for vector depth. The GX5283 supports 128 Mbits per channel when in 32 channel configuration, and is programmable down to a width of 1 channel with a depth of 4 Gbits. Widths of 32, 16, 8, 4, 2 and 1 channel(s) are supported. All GX5280 Series boards provide programmable TTL/LVTTL output clocks and strobes, and support external clock and strobe. Programmable PLLs (phase locked loop) provide configurable clock frequencies and delays. The GX5283 additionally provides a LVDS output clock.

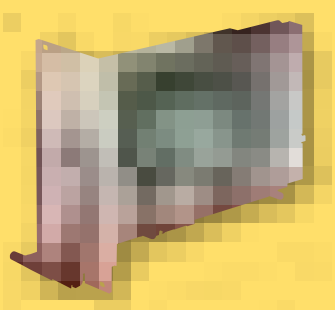
Geotest-Marvin Test Systems
Irvine, CA.
(949) 263-2222.
[www.geotestinc.com].

Pentium III CompactPCI/PXI Board Sports Cyclone FPGA

As a spin-off from CompactPCI, the PXI form-factor gets to leverage off the critical mass and rich ecosystems achieved by CompactPCI. Serving that need, MEN Mikro Elektronik is introducing F11, another single board computer in CompactPCI single Eurocard format. It is based on the mobile Low-Power/ Low-Voltage Intel Pentium III processors and was designed for application in harsh industrial environments. Combined with the Cyclone FPGA from Altera, the F11 is far more flexible than any usual PC, since the system I/O required is available for each individual application in the form of IP cores.

The 3U card can be used as a system master in a CompactPCI system or as a stand-alone board with single 5V supply. The Low-Power versions of Celeron / Pentium III used on F11 have a clock frequency of between 400 and 933 MHz and provide for relatively moderate heat development. A dedicated heat sink makes for efficient heat transfer in fan-less systems or in the extended temperature range.

The F11 has two Fast Ethernet and two RS-232 interfaces, which are accessible at the front through RJ45 or—as an option—D-Sub connectors. Dual USB, graphics (VGA up to UXGA) and keyboard/mouse are also available at the front. Rear I/O support includes four PXI triggers, IDE, COM, USB and PS/2. As for memory, there are up to 512 Mbytes of SO-DIMM, SRAM, CompactFlash and a slot for a



2.5-in. hard disk. The industrial BIOS comes from Award and supports FPGA function, operation without graphics, Ethernet boot via backplane and so on.

Application-specific functions can be implemented in a flexible way and individually in the FPGA on F11. With line drivers on serial interface adapters (SA-Adapters) these functions are led to the front panel, which can vary in its width between 2 and 7 slots depending on the set-up.

MEN Micro
Lago Vista, TX.
(512) 267-8883.
[www.menmicro.com].

Board Duo Generates RF Signals 300 Times Faster

Wireless communications is perhaps the most vital technology enabling the U.S. Military's push for net-centric operations. Engineers and scientists now can generate RF and baseband signals more than 300 times faster with the new National Instruments PXI-5671 RF vector signal generator and the new NI PXI-5441 (shown) arbitrary waveform generator with onboard signal processing.

The PXI-5671 module is a three-slot RF vector signal generator that delivers signal generation from 250 kHz to 2.7 GHz, 20 MHz

of real-time bandwidth and up to 512 Mbytes of memory. With the onboard digital upconverter on the module, engineers can achieve more than 300 times faster waveform download time or playback duration. This functionality is ideal for engineers who require data streaming with rapid response time for software defined radio (SDR) or faster download times for satellite radio applications.

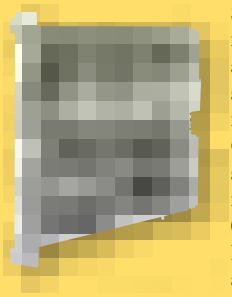
The PXI-5441 module, a 100 MSample/s arbitrary waveform generator for producing standard functions, arbitrary waveforms and waveform sequences, introduces onboard signal processing functionality. Onboard signal processing adds baseband interpolation/pulse shaping and quadrature digital upconversion capability for generating baseband I/Q and intermediate frequency (IF) signals up to 43 MHz.

The PXI-5671 and PXI-5441 modules ship with the new NI Modulation Toolkit 3.0 for LabVIEW. In addition to its ability to rapidly prototype any standard-specific or custom digital communication system, the software now includes channel coding, channel equalization and channel models as well as new, easy-to-use pallet functions for ASK, PAM, AM-VSB and AM-SSB modulation formats. Because the Modulation Toolkit tightly integrates with NI hardware, engineers can use the software to easily perform hardware-in-the-loop testing. The NI PXI-5441 is priced from $8,495, while the NI PXI-5671 is priced from $16,495. The NI Modulation Toolkit is priced from $1,995.

National Instruments
Austin, TX.
(512) 683-0100.
[www.ni.com].

Synchro/Resolver Processor Card Boasts 0.005° Accuracy

Synchro/resolver converters are electromechanical transducers designed to convert mechanical angles to electrical signals; combined with analog and digital I/O, they provide a complete system solution for fire control systems and radar position tracking. North Atlantic Industries (NAI) provides instrument-grade, high-density, DSP-based VXI cards that incorporate up to four synchro/ resolver instrument measurement channels, up to four synchro/resolver instrument stimulus channels or up to eight synchro/resolver converter-grade stimulus channels, and up to six programmable reference supplies. All functions are independent, user-programmable for either synchro or resolver format and can be formatted for single- or multi-speed applications. The unit incorporates an internal wrap-around self-test function that does not require external hardware or software.



Synchro/resolver measurement and instrument stimulus accuracy is to within 0.005. Converter-grade stimulus accuracy is 0.015° loaded and 0.008° with no load. Instrument stimulus and reference outputs provide 2.2 VA of drive and are programmable from 47 Hz to 4,000 Hz.

The 65CS4 C-size VXI card is a full-function instrument capable of performing most synchro/resolver evaluation, calibration and test functions on components, assemblies and systems. The stimulus channels can be programmed for continuous rotation up to 13.6 RPS or for specific start and stop angles. The measurement channels can track signals up to 4.68 RPS. Stimulus and measurement channels can be programmed for speed ratios of 2:1 through 255:1. Measurement channels provide both digital and DC angle-rate output signals. The card provides a VXI data rate of 2 Mbytes/ s, dynamic address configuration and 100 µsec data processing. The 65CS4 is available with an operating temperature range of 0°C to +50°C. Its power supply requirement is +5 VDC at 8A (no load). Pricing for 100 pieces starts at $10,000 each. Delivery is 8 to 10 weeks ARO.

North Atlantic Industries
Bohemia, NY.
(631) 567-1100.
[www.naii.com].

48 VDC Power Supply Targets Both PXI and VXI

It's relatively rare to find a product that works equally well with both PXI and VXI systems. But the DH-226 power supply from Tracewell Systems is designed to provide power for both PXI and VXI applications. It features eight independently regulated outputs that will deliver full-rated current to meet these power requirements. Maximum output is 1488 W at 45°C with 400 LFM of air and typical efficiency is 90%. A special 12 VDC output is provided to operate system fans. Each output is independently thermally protected, and multiple supplies can be combined in a system with full load sharing. In keeping with the best of modern distributed power architectures, the power supply operates from a 48 VDC system bus, which is especially useful in high-power applications. The unit's high efficiency makes it ideal for portable or battery-powered applications; it also allows it to be cooled entirely by system air. The DH-226 is the size of a standard VXI card at 6U high by 7 hp wide, and weighs 6 pounds.

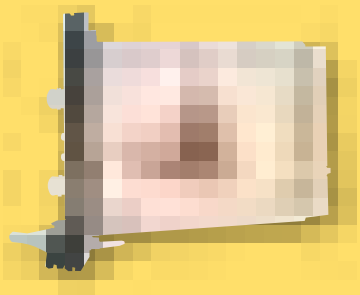
The front panel has LED status indicators for INPUT OK, OUTPUT OK and POWER SUPPLY FAIL. RS-485 communications allow the status, internal and remote temperature sensors, external fan speed and output voltages of the power supply to be remotely monitored. Also standard is an open-collector SYSTEM RESET output (which can also function as a POWER GOOD signal). The power supply

has been tested in a system to 50 Gs random vibration, and has been HALT tested at 1 kW load from -30°C to +80°C. Pricing for the DH-226 VXI/PXI Power Supply starts at $2,670 (min. quantity 10 units) and availability is 8-10 weeks ARO.

Tracewell Systems
Westerville, OH.
(614) 846-6175.
[www.tracewellsystems.com].

14- and 16-bit High-Speed, High-Precision DSOs Roll

Instrumentation architectures like PXI and VXI let you integrate tools like digital oscilloscopes into your test system. Along those lines, ZTEC Instruments offers the ZT410 family of digital storage oscilloscopes for PXI, PCI and VXI. Available in both 14- and 16-bit versions, the ZT410 family combines traditional bench top oscilloscope features with high-precision measurement capability. The instrument's low noise, distortion and drift provides the dynamic range needed for even the most demanding measurement applications.



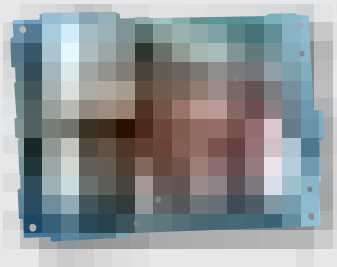
Like all ZTEC modular instrument products, the ZT410 family is designed to include capabilities familiar to the bench top oscilloscope user. These capabilities include flexible signal conditioning, advanced triggering, multiple acquisition modes, onboard signal processing and much more. Even features like auto-setup and auto-calibration are included.

In addition to bench top capabilities, the ZT410 family provides all the features found in today's modular digitizers, such as state-of-the-art data conversion technology and deep onboard sample memory. The product's modular architecture is ideal for applications with high channel count requirements. Multiple products can be synchronized together using the local timing and trigger bus.

The ZT410 family is available in PCI, CompactPCI/PXI and VXI form-factors. The PCI and CompactPCI/PXI versions will be available in early Q1 2006. The VXI version will be available shortly thereafter. Please contact ZTEC Instruments for more information.

The 410-20 (14-bit) and the 410-50 (16-bit) both start at $5,495 and they go up to $6,495 with the 16 Msample memory upgrade. Both the PCI and PXI versions of the DSO will be available early Q1 2006. The VXI version will be available shortly thereafter.

ZTEC Instruments
Albuquerque, NM.
(505) 342-0132.
[www.ztec-inc.com].



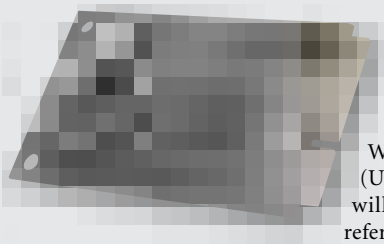
OPTO Expansion Card Delivers I/O Voltage Isolation

High-performance, I/O-intensive applications often require high-voltage isolation. The flexible I/O base address range and 16-bit pass-through connector in a new user-configurable EPIC-sized OPTO expansion card from Micro/sys is designed for rugged systems with analog and digital I/O that require high-voltage isolation.

The OPTO104 accommodates eight industry-standard digital or analog OPTO plug-in modules, as well as PC/104 CPU or I/O cards. Any combination of digital or analog I/O modules can be plugged into the 4.53-in. x 6.50-in. EPIC-sized board. For applications demanding more I/O, up to four OPTO104 boards can be connected in a slave configuration using a 26-wire ribbon cable. This produces 32 available slots for OPTO 22 G4 modules for AC or DC digital I/O, and/or Grayhill G5 modules for analog I/O. All of these modules offer opto-isolation up to 4000V.

The board operates at 5V ± 5%, with an extended operating temperature range of -40° to +85°C. Alternately, DC/DC converter options allow input voltages from 9V to 75V. A user-selectable jumper can bleed off common mode leakage current to the negative inputs or to safety ground. Price is $375 in single quantity.

Micro/sys, Montrose, CA. (818) 244-2600. [www.embeddedsys.com].



Wireless USB Reference Design Kit Aims at Ultrawideband

Designers of emerging WiMedia-based ultrawideband (UWB) communication systems will get a boost from a new reference design kit based on Certified Wireless USB from the USB Implementers Forum. The reference design, in the form of a PCI Express mini card, incorporates WiQuest's WQST110/101 ultrawideband chipset, which can be used to build complete device wire adapter or host wire adapter solutions.

The reference design kit contains hardware and software, including schematics, layout source files, a detailed bill-of-material and design and user manuals. Depending upon the configuration, the software package includes drivers and/or firmware for a host wire adapter and/or a device wire adapter. It also includes a Windows-based utility that supports device discovery, field upgrade functionality, comprehensive diagnostics and the newly defined wireless USB association models.

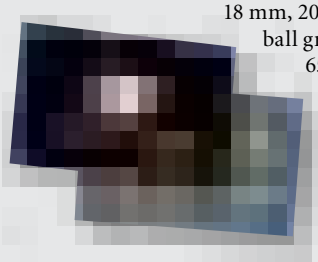
When coupled with WiQuest's Wireless USB Adapter, Wireless USB Hub or another Wireless USB PCI Express mini card on the device side, the PCI Express mini card hardware and software provide a complete, highly integrated, end-to-end solution. The list price for the wireless USB PCI Express mini card reference design kit is $30,000 for evaluation.

WiQuest Communications, Allen, TX. (214) 547-1606. [www.wiquest.com].

SDRAM PBGA Comes in High-Rel Multi-Chip Package

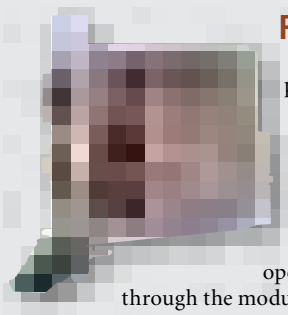
Feeding the harsh environment, mil-temp demands for ruggedized, high-reliability SDRAM memory, White Electronic Designs has announced availability of its 2 Gbyte DDR2 SDRAM plastic ball grid array (PBGA) multi-chip package. The component is designed to complement high-performance processors and memory controllers for high-reliability applications and is available in commercial, industrial and military temperature ranges.

The SDRAM is organized as 32M x 72 and packaged in a 20 mm x 18 mm, 208-ball PBGA. Compared to a fine pitch ball grid array (FPBGA), the PBGA offers 65% space savings, a 54% reduction in I/O, reduced trace lengths for lower parasitic capacitance and reduced parts count. The SDRAM features internal pipelined DDR architecture enabling two data accesses per clock cycle. It provides programmable read or write burst lengths of 4 or 8, four internal banks allow concurrent operation and it features differential data strobe (DQS, DQS#) per byte for transmitting and receiving data.



The 32M x 72 DDR2 SDRAM MCP, part number W3H32M72E-XSBX, is priced at $200 each in volumes of 1,000 pieces. Lead time is 6 weeks.

White Electronic Designs, Phoenix, AZ. (602) 437-1520. [www.wedc.com].



Programmable Power Supply Is Highly Accurate

Military engineers now can source voltage or current with high accuracy from a single PXI slot with a new programmable DC power supply. The PXI-4110 from National Instruments exceeds the accuracy of other PXI power supplies with high-resolution setpoints and readback measurement capability while reducing test times with programming speeds less than 1 ms.

The PXI-4110 is a programmable, triple-output precision DC power supply in a single-slot, 3U PXI module. Two isolated channels, one from 0 to +20V and the other from 0 to -20V, and a single non-isolated 0 to 6V supply can output up to 1A per channel. 16-bit resolution setpoints, selectable 20 mA current range and readback measurements can be used to program 0.12 mV changes in voltage and 0.4 µA changes in current. The module has 9W of output power operating from the PXI backplane supply. Up to 20W per channel is possible when connected to an auxiliary power supply through the module's front panel.

The PXI-4110 works with NI modular instruments, the NI LabVIEW graphical development environment, the LabWindows/CVI ANSI C development environment and Microsoft Visual Basic/C++. It includes a test panel and Express VI for simple troubleshooting and fast application development. Price is $1,499.

National Instruments, Austin, TX. (512) 683-0100. [www.ni.com].

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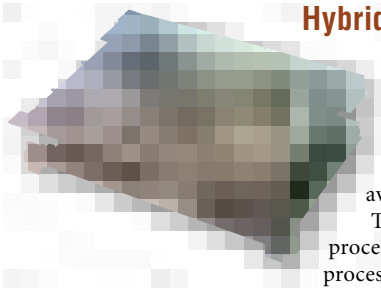


Hybrid FPGA/PowerPC Processor Is Fully Rugged

In high-performance military applications demanding increasingly powerful front-end signal processing, lots of compute power and ruggedization are needed. A new hybrid FPGA/PowerPC processor card from Radstone is available in four ruggedization levels.

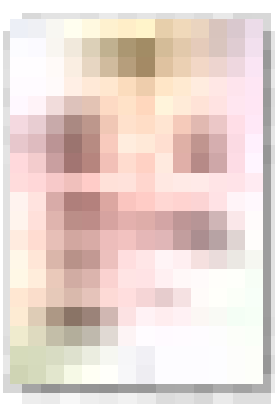
The V4DSP features dual Virtex-4 FX 60/100 FPGA processing nodes combined with a Freescale MPC7448 PowerPC processor operating at speeds of up to 1.4 GHz. The MPC7448 PowerPC's AltiVec general-purpose processing node can be used as the first back-end application processing stage to reduce chassis slot count. The card has two StarFabric ports at the P0 connector to enable multiboard connectivity. For mezzanine support, either a 64-bit/66 MHz PMC site can be configured, or an XMC site equipped with eight multi-gigabit transceivers to the two Virtex-4 nodes, each operating at up to 3.125 GHz.

Included are a Radstone Board Support Package (BSP) and V-Wrap, a comprehensive FPGA intellectual property (IP) wrapper, which is Radstone's pre-prepared set of VHDL interfaces to the Virtex-4's embedded I/O and memory. Also included is support for Radstone's acclaimed AXIS Advanced Multiprocessor Integrated Software environment for developing highly scalable multiprocessor systems. The V4DSP is available in four ruggedization levels. Price for a single, level-one unit is $13,606 in OEM quantities.

Radstone Embedded Computing, Towcester, UK. +44 (0) 1327 359444. [www.radstone.com].

Virtual Platform Available for Multi-Threaded MIPS32 34K Cores

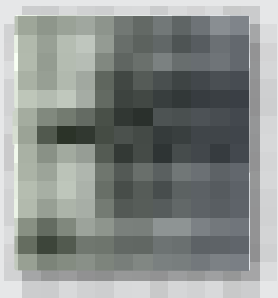
Military system designers building high-performance embedded systems with the MIPS32 family of 34K cores need a thorough understanding of multi-threading techniques. A new version of the Virtio Virtual Platform, the VPMM-SC, lets development teams perform in-depth evaluations of this technology's impact on their designs.



The VPMM-SC Virtual Platform provides fast system simulation of the MIPS32 34K core-based MALTA development board. Developers can quickly reconfigure the MIPS32 34K cores in a variety of different multi-threading configurations and evaluate the system impact with detailed internal core statistics. The platform uses a combination of C-code, graphical modeling and transaction-based modeling to replicate the full functionality of the MALTA board in a PC-based simulation.

The VPMM-SC supports the MIPS32 4KE, 24K and 34K core family members and offers a choice of instruction-accurate and cycle-accurate CPU models. The VPMM-SC supports standard operating systems such as Linux. It can execute binary code files that target the MALTA board and integrates with essential software development tools such as Green Hills MULTI and GDB debuggers. Pricing starts at $1,990.

Virtio, Campbell, CA. (408) 341-0844. [www.virtio.com].



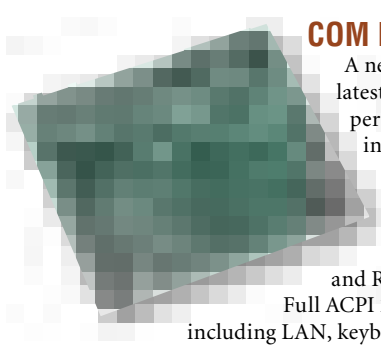
Backplane Implements New VXS Processor Mesh Architecture

The VXS Processor Mesh architecture recently proposed to VITA delivers 112.5 Gbytes/s of aggregate throughput within the processing mesh in a single chassis, a 6x improvement over currently available technology. The industry's first 12-slot backplane that implements this architecture is now available from Elma Bustronic.

This hybrid backplane was developed to enable a switch/processor mesh technology for applications requiring multiple boards for application processing. It implements two VME64x slots, three VME64x/VXS payload slots and six VXS switch slots. Each switch slot implements twenty x4 links for a total of 25 Gbytes/s per switch slot. The system architecture supports throughput of up to 7.5 Gbytes/s between the I/O front-end and the processing mesh.

Other features include a rear-facing I/O slot that conglomerates all of the payload slot rP0 reserved pins, 16 pins dedicated to user I/O from each of the processor slots and two channels served by the dual-dual star VXS fabric switch. Pricing begins at $3,000, depending on configuration.

Elma Bustronic, Fremont, CA. (510) 490-7388. [www.elmabustronic.com].



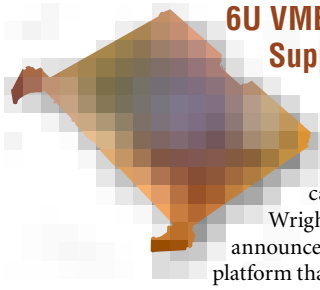
COM Extends Design Life of ETX-Based Systems

A new XTX 820 Computer-on-Module (COM) from Ampro Computers gives military system designers access to the latest chipset technology without the need to completely redesign their ETX baseboards. Based on a Pentium M with performance of up to 1.8 GHz, the XTX 820 COM retains legacy peripherals while offering the latest high-speed interconnect and storage technologies.

The XTX 820 COM plugs into a baseboard to allow customization of board size and shape, I/O circuitry, connector locations and easy migration to higher performance modules. It includes 1 GHz, 1.4 GHz or 1.8 GHz processors, the Intel 915GM chipset and up to 1 Gbyte of DDR 400 RAM. For expansion and connectivity, the COM features six USB 2.0 ports, EIDE and SATA interfaces, 10/100 Ethernet, PCI expansion and RoHS compliance.

Full ACPI 2.0 support, including S3 suspend-to-RAM, is included. AMI BIOS provides full support for wake-up devices including LAN, keyboard, mouse, power button and PCI or SMBus activity. XTX 820 QuickStart Kits include drivers and Board Support Packages (BSPs) for Windows XP, Windows XP Embedded, Windows CE 5.0, VxWorks and QNX, and a full Linux 2.6 distribution (Fedora Core 3). Prices start in the low $500s in moderate quantities.

Ampro Computers, San Jose, CA. (408) 360-0200. [www.ampro.com].



6U VME Graphics/Imaging Platform Supports Radar and Video

Semiconductor integration is empowering a new generation of board-level solutions that blend multiple, high-performance functions into a single-slot card. Exemplifying that trend, Curtiss-Wright Controls Embedded Computing has announced Sabre, a new graphics and imaging platform that combines support for onboard radar scan conversion and video capture on a single 6U VMEbus card.

Based on an IBM 750GX PowerPC processor, Sabre's dual onboard 250 MHz ATI M9 high-performance graphics processors independently support DVI resolutions of up to 1900 x 1280. 64 Mbytes of integrated video memory are supplied for each processor. Support for dual channels of TV and RGB at resolutions of up to 1600 x 1200 is included, as well as support for the simultaneous acquisition and display of two real-time NTSC/PAL, RGB or compressed network video sources.

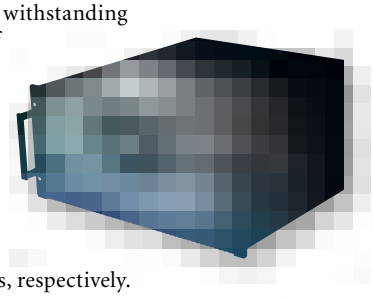
Radar scan conversion is handled via an optional Eagle-S PMC mezzanine card. The Eagle-S processes radar video, which is scan-converted into one or more display windows in PPI or B Scope formats. Dual 10/100/1000 Base-TX Ethernet interfaces—one via the front panel, the other via VME P2—are included. Additional I/O available from the front panel includes dual DVI-I video outputs and dual USB interfaces. Pricing for the Sabre starts at $7,500.

Curtiss-Wright Controls Embedded Computing, Dayton, OH. (937) 252-5601. [www.cwcembedded.com].

Euro-Cage Enclosure Withstands Multiple Insertions/Extractions

A new powered enclosure provides superior performance and improved durability in critical military and aerospace applications. The D+1600 Series enclosure from Triple E meets current IEEE 1101.10/IEEE 1101.11 specifications, Mil-Specs for shock/vibration and EIA/IEC rackmount standards.

The D+1600 Series enclosure features solid aluminum construction to provide structural integrity and increased protection of boards during rigorous use. Triple E's stainless steel inject/eject plate provides up to 104 lbs. of insertion/extraction force, withstanding unlimited injection/ejection cycles of boards with high connector pin counts. Unlike plastic, the extruded aluminum card guide system does not flex or break and maximizes cooling air flow between the card guides.



Models D+1605 and D+1607 can accommodate up to five or seven horizontally mounted 6U 4HP boards, respectively. Both models include ball bearing fans, an auto-ranging power supply and either a VME64X or a CompactPCI backplane. Options include desktop or rack mount style, front mount drive bays, a rear-mounted 80 mm I/O plug-in unit and a choice of power supply up to 500W. Pricing for single units of models 1605 and 1607 starts at $2,679 for the VME64X version and $2,547 for the cPCI version.

Triple E, Lowell, MA. (978) 453-1196. [www.tripleease.com].

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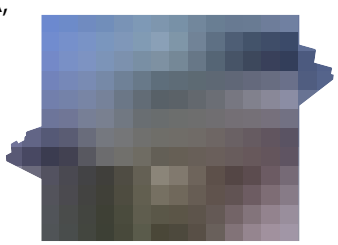

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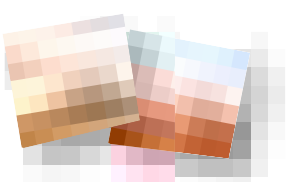

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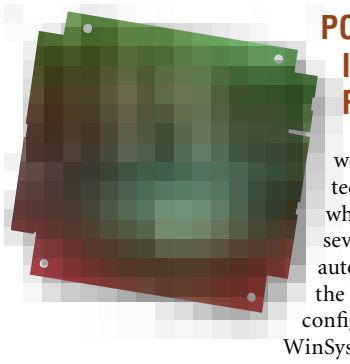


PC/104 Analog and Digital I/O Card Has Wide Temp Range

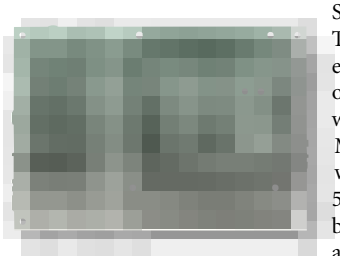
PC/104 remains popular as a workhouse embedded computing technology for remote fielded systems, where environment conditions are severe. Such systems need to be as autonomous as possible to minimize the hands-on maintenance and configuration. Along just such lines, WinSystems introduced its PCM-MIO, a high-density analog and digital I/O card that operates from -40° to +85°C. This PC/104-compliant card includes a 16 channel, 12-bit analog-to-digital (A/D) converter, 8 channel, 12-bit digital-to-analog (D/A) converter, and 48 lines of digital I/O. Its design is unique since it requires no trimpots for calibration of the analog circuitry to remain within its specifications. No onboard potentiometers to adjust results in quick and easy setup of analog systems needing accurate digitally controlled voltages. This also eliminates the need for a technician to readjust or recalibrate the unit.

The input voltage ranges are 0-5V, ±5V, 0-10V and ±10V. The output voltage ranges are 0-5V, 0-10V, ±5V, and ±10V. There are 48 lines of digital I/O individually programmable for input, output or output with read-back. The PCM-MIO measures 3.6 x 3.8 inches (90 mm x 96 mm) and is PC/104-compliant. List price for the PCM-MIO-12 is $395.

WinSystems, Arlington, TX. (817) 274-7553. [www.winsystems.com].

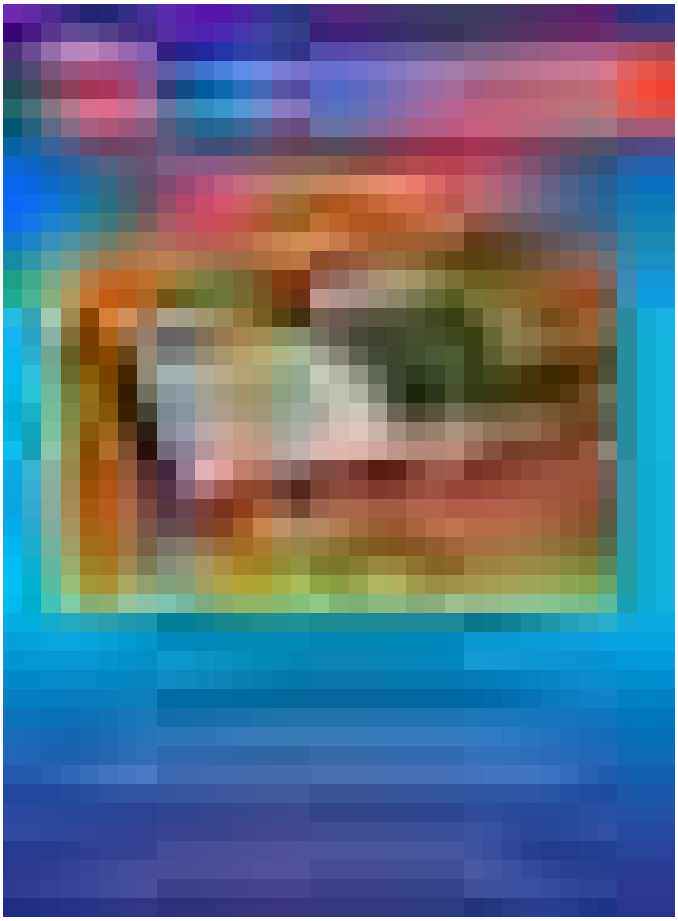
EPIC SBC Boasts Integrated Data Acq

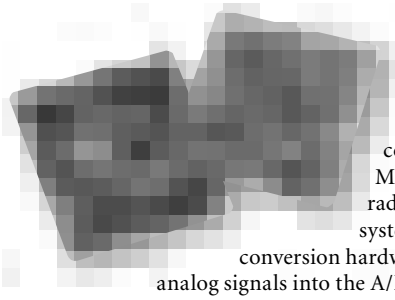
Now only a couple years old, the EPIC form-factor is rapidly gaining momentum. The military in particular has long had their eye out for larger follow-on to PC/104, and EPIC seems to feed that need. Diamond Systems' latest EPIC offering is the Poseidon SBC, an EPIC form-factor SBC with integrated data acquisition. The new Poseidon SBC is offered with either a fanless 1.0 GHz VIA Eden ULV or 2.0 GHz VIA C7 processor, both with 256 Kbyte on-chip cache and 400 MHz front side bus. The board comes with either 256 Mbyte or 512 Mbyte 533 MHz DDR2 RAM soldered on the board for improved resistance to shock and vibration.



Poseidon's data acquisition circuit incorporates the features and capabilities of the industry-leading Diamond MM-32X-AT board, including 32 16-bit analog inputs with a 250 KHz sampling rate, 4 12-bit analog outputs, 24 programmable digital I/O lines and two counter/timers. Poseidon will be available for initial delivery in Q2 2006 with production shipments beginning in Q3. Versions will be available with and without data acquisition. Prices start under $700 in quantity 1-9. Volume discounts are available.

Diamond Systems, Mountain View, CA. (650) 810-2508. [www.diamondsystems.com].





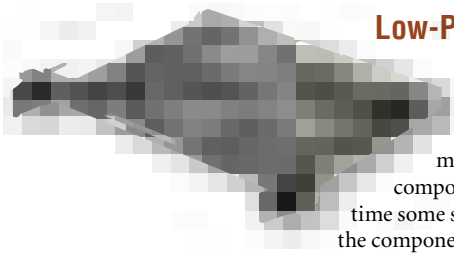
Monolithic A/D Converter Doubles Available Speed

Because 12-bit A/D converters are limited to 250 Msamples/s, designers of defense radar and communications systems must use several down-conversion hardware stages before entering the analog signals into the A/D converter, and interleave several A/D converters to get high data rates. A new monolithic 12-bit A/D converter from Atmel has a clock frequency of 500 Msamples/s. This allows system designers to accurately digitize signals with frequencies of up to 250 MHz at sampling rates that could not have been achieved before with 12-bit resolution.

Thanks to its 0.5 dB band flatness from DC to 250 MHz, the AT84AS001TP provides 62 dBc SNR, 75 dBc SFDR and 10 ENOB at 500 Msamples/s over the first Nyquist zone with two-tone inter-modulation distortion limited to -70 dB. It dissipates only 2.3W with 3.3V and 5V power supplies. The required analog input signal amplitude is only 1.1 Vpp, and can be AC or DC coupled. An integrated three-wire serial interface offers software control of the A/D converter gain and offset.

The AT84AS001TP is packaged in a plastic TBGA192 package and will be offered in both commercial and industrial temperature ranges. Samples are available now, with production quantities in Q4 2006. Unit price is $98 for a 1K-piece quantity in commercial grade.

Atmel, San Jose, CA. (408) 441-0311. [www.atmel.com].



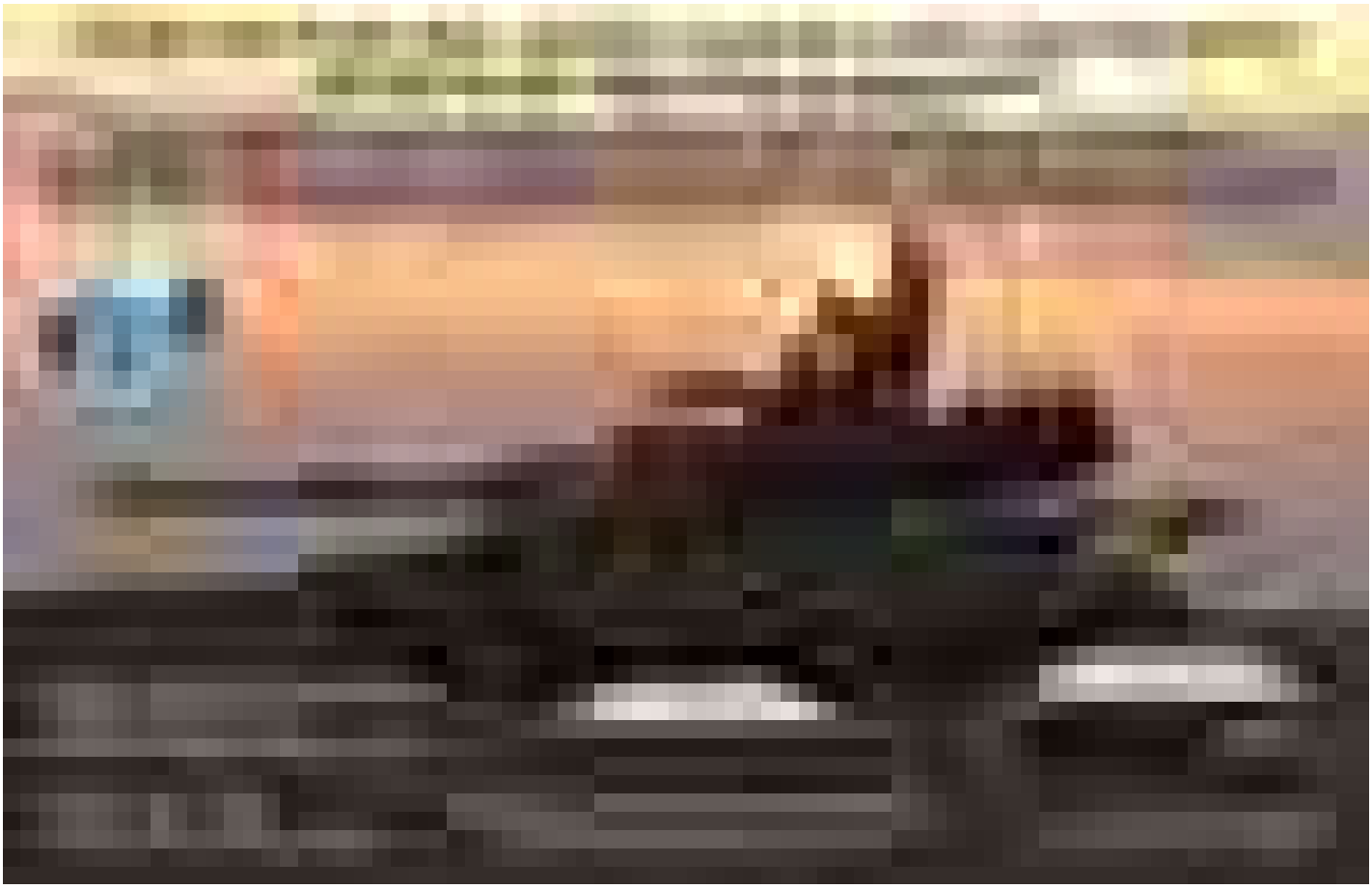
Low-Power SBC's CPU Module Is Field Replaceable

If there's one thing military systems need, it's component longevity. By the time some systems are actually built, the components may be obsolete. A new VMEbus-based SBC from General Micro Systems virtually eliminates processor obsolescence by housing the CPU in a module that is field-upgradeable, with a minimum life cycle of 10 years.

The Pentium M-based CONDOR V265's 4 x 4 (P60x) CPU module enables complete technology insertions in the field while maintaining integrity of the software, system and I/O functions on the baseboard and the end-user system. Up to 2 Gbytes of 266 MHz DDR SDRAM is provided, along with two independent PCI buses, one a PCI-X-compliant bus connected to a dual Gigabit Ethernet device and one a PMC site. Up to 10 multi-protocol communications controllers are supported. An onboard dual pipe video controller with 64 Mbytes of 64-bit memory provides two independent video channels.

The CONDOR is available in two convection-cooled versions: 0° to 55°C with airflow of 400 linear feet per minute, and -40° to + 85°C rugged assembly. Conduction-cooled versions are also available. Software support for Windows XP/2000, VxWorks, Tornado II and Linux are provided. Pricing starts at $2,156 each in quantities of 100 units.

General Microsystems, Rancho Cucamonga, CA. (800) 307-4863. [www.gms4sbc.com].



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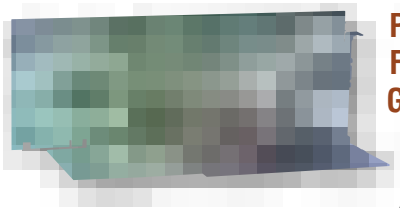


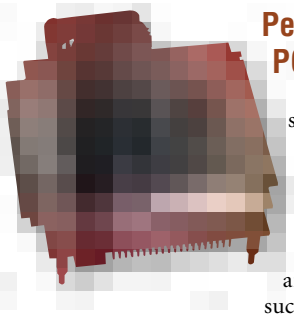
PCI Express SBC Features Advanced Graphics

A majority of military computing applications don't need battlefield ruggedness. And especially with U.S. Military's move toward Network-Centric Operations, that's a multitude of graphical interface requirements for installations throughout that network. Focusing on advanced graphics needs, Trenton's TML graphics-class system host board (SHB) uses the Intel Core Duo, Intel Core Solo and Intel Celeron M processor options to deliver superior system performance per watt.

The x16 PCI Express and x4 links on edge connectors A and B of the TML support PCI Express video and graphics cards, ADD2 cards and general-purpose option cards on a PICMG 1.3-compatible backplane. Trenton TML customers can elect to use the internal video connection on the SHB instead of a card connected to the x16 PCI Express link. This video option is driven by the chipset's Intel Graphics Media Accelerator 950.

PCI Express links designed into the TML support the high-speed PCI Express interface methodology between the SHB and backplane defined in the PICMG 1.3 industry standard. The TML is available now with a list price of $1,425. Pricing and processor speed availability varies.

Trenton Technology, Atlanta, GA. (770) 287-3100. [www.trentontechnology.com].

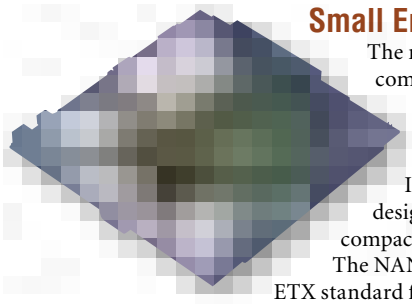


Pentium M SBC Offers Complete PC/104-Plus Solution

Squeezing a complete Pentium M SBC solution—with all the usual PC graphics and I/O—into the compact PC/104-Plus form-factor is no small feat. VersaLogic did just that with their Cheetah SBC. The board is targeted at applications requiring substantial processing power and extensive features in a compact design, such as avionics, navigation/tracking, system monitoring and security/homeland defense markets. It is especially suited for embedded control applications requiring a very small footprint, which the 3.6 x 3.8-in. board provides. Standard onboard features include two COM ports, two USB 2.0 ports, Ethernet, IDE, LPT, audio and PS/2 keyboard/mouse support. The board also features integrated high-performance video output with support for both analog monitors and LVDS flat-panels. The Extreme Graphics 2 video processor includes high-speed 3D rendering, full-motion video and MPEG-2 decoding.

The PC/104-Plus interface supports both ISA and PCI add-on modules. Standard pass-through connectors allow the board to be stackable with other PC/104 modules. It may also be used as a CPU module for larger systems, by plugging it into a proprietary base board that includes specific user I/O circuitry. As with other VersaLogic embedded computer boards, the Cheetah includes a customizable, OEM-enhanced BIOS that is field-upgradeable. Pricing is about $1,500 in OEM quantities.

VersaLogic, Eugene, OR. (541) 485-8575. [www.versalogic.com].

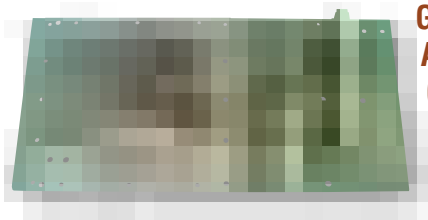


Small Embedded Server Works with PC/104 and ETX

The magic of semiconductor integration keeps shrinking the amount of space needed for a full-feature embedded computer. Exemplifying that trend, ACCES I/O Products has introduced its NANO I/O Server. The unit is designed to support the ACCES I/O line of USB and PC/104 I/O modules along with the high-performance benefits of ETX. Featuring a motherboard/baseboard only 120 mm across, the NANO right-angle mounted connectors include VGA, RS-232, four USB 2.0 ports, PS/2 mouse and keyboard and Ethernet. ACCES I/O's experience in providing OEMs with custom ETX baseboards is highlighted by this dense motherboard design. By integrating its proven I/O designs with this new small motherboard expertise, the product enables compact ETX I/O baseboard solutions ideal for space-sensitive applications.

The NANO I/O Server is unique due to the capability of utilizing any embedded ETX CPU board that meets the ETX standard for its processing, while providing PC/104 I/O module expansion. Whether the application requires a high-end 1.8 GHz Pentium M, a fanless mid-range 600 MHz Celeron M, or a very low-power 100 MHz processor. Pricing is $229, quantity one for motherboard only. System pricing depends on choice of ETX CPU and I/O requirements.

ACCES I/O Products, San Diego, CA. (858) 550-9559. [www.accesio.com].



Geode Climbs Aboard Conduction-Cooled XMC

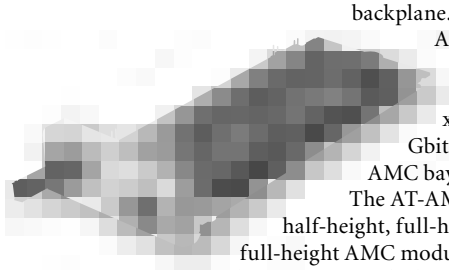
If the success of PMC is any indicator, its follow-on mezzanine form-factor XMC is sure to gain wide appeal in the defense market. PCI Embedded Computer Systems, joined in with the first conduction-cooled XMC CPU board aimed specifically at low-power embedded systems. The card's onboard AMD Geode LX 800 processor operates at a maximum power of 3.9W and 1.8W typical at 500 MHz. Coupled with the AMD Geode CS5536 companion device, the combined chipset, which operates at 1.9W typical at 433 MHz and at 2.4W typical at 500 MHz, offers designers a complete set of features that can deliver full desktop functionality to embedded and portable devices.

XMC Modules interface to a baseboard through high-speed connectors. XMC modules are 149 mm x 75 mm, allowing wide flexibility in OEM baseboard form-factors. The XMC Geode 800 conduction-cooled board prices start under $550 each in volume, including the CPU. An XMC Geode 800 Development Kit containing the base board, power supply, CD-ROM drives, IDE/SATA cables, debug modules, documentation and utility software is available for $1,995.

PCI Embedded Computer Systems, Jackson, CA. (209) 295-5088. [www.pcisystems.com].

AMC Carrier Blade Family Has 2- and 4-Bay Versions

Just how much of an impact ATCA will have in the military isn't yet clear. But odds are that the AMC mezzanine created for ATCA will be a slam dunk. SBS Technologies has introduced an ATCA carrier blade series. The AT-AMC1 is an AMC.1-compliant carrier blade supports half-height, full-height and extended full-height AMC modules. It features two Gbit Ethernet ports to the base interface and four Gbit Ethernet ports (2 channels, 2 ports per channel) to the fabric interface of the AdvancedTCA backplane. AT-AMC1 features three AMC bays supporting x4 PCIe interfaces and one AMC bay supporting an x8 PCIe interface, plus two Gbit Ethernet lanes to each AMC bay.



The AT-AMC2 carrier blade supports half-height, full-height and extended full-height AMC modules. It features two Gbit Ethernet ports to the base interface and ten Gbit Ethernet ports (4 channels, with 4,4,1,1 port distribution) to the fabric interface of the AdvancedTCA backplane. The AT-AMC2 features x4 Gbit Ethernet lanes to all AMC bays on lanes 4-7 and two Gbit Ethernet lanes to each AMC bay in the Common Options region. List price starts at $1,850. The AT-AMC1 and AT-AMC2 will be available in limited samples in Q2 and volume quantities in Q3 2006.

SBS Technologies, Albuquerque, NM. (505) 875-0600. [www.sbs.com].

Processor-Independent Switched Platform Eases Thermal Woes

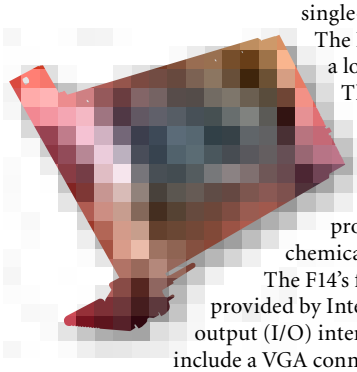
Reducing space, weight and power (or SWAP) together lead to the most challenging hurdles for today's mission-critical distributed computing systems. Themis Computer is tackling that problem head on with its new Themis Slice Architecture. A processor-independent architecture, the Themis "Slice" platform allows users to mix, match and manage SPARC and x86 architectures, Solaris, Windows and Linux operating systems, in combination with third-party network servers, storage and switches.

All Themis Slice elements are inherently rugged, have a uniform mechanical footprint and a standard rack height (1-RU) and depth (22 in.). Up to five Slice elements, including a common Power Slice can be combined in a 5RU docking station, or Subrack. The Subrack blind mates with connectors on the Slice element, providing power distribution, cable management and dripless couplings for liquid cooling of the constituent Slice Subrack modules. A single Slice processing element can be organized as 2-16 way SMP nodes. Up to four Processor Slices with up to 64 cores can be configured in a single 5U Subrack. The cluster fabric, internal to the Subrack uses InfiniBand switches and links, for superior (low) memory-to-memory transfer latency and scalable bandwidth. Subrack clusters can be configured using either Gig-E or InfiniBand. Processor Slices are priced from $10,500. Processor Slice configurations bundled with the subrack docking station and power supplies, are priced from $26,000 in OEM quantities.

Themis Computer, Fremont, CA. (510) 252-0870. [www.themis.com].

2 GHz Pentium M SBC Blends cPCI and PCIe

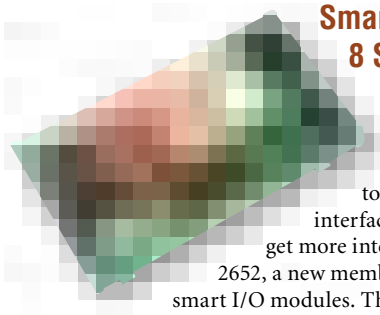
PCI Express is making major inroads into nearly every flavor of embedded computing form-factors. Using it in a CompactPCI board, MEN Micro's F14 SBC features a two-GHz Intel Pentium M processor in a single-slot 32-bit/33 MHz cPCI system master or stand-alone SBC in a single-wide 3U CompactPCI form-factor.



The F14 can be also be configured with a low-power Celeron M processor. The SBC is capable of operating over the entire extended temperature range of -40° to 85°C. In addition, the F14 can be delivered with an optional conformal coating that protects it from humid and corrosive chemicals in the environment.

The F14's four lanes of PCI Express are provided by Intel's 915GM chip set. The input/output (I/O) interfaces at the front panel on the F14 include a VGA connector for graphics, the two Gbit Ethernet channels and two USB 2.0 ports. Onboard memory resources include up to two Gbytes of fast double data rate (DDR2) DRAM. A CompactFlash slot is available for additional memory, or a 1.8-in. hard disk drive can be installed onboard. The F14 is available now from MEN Micro, Inc. Pricing starts at $1,194 for single units.

MEN Micro, Lago Vista, TX. (512) 267-8883. [www.menmicro.com].

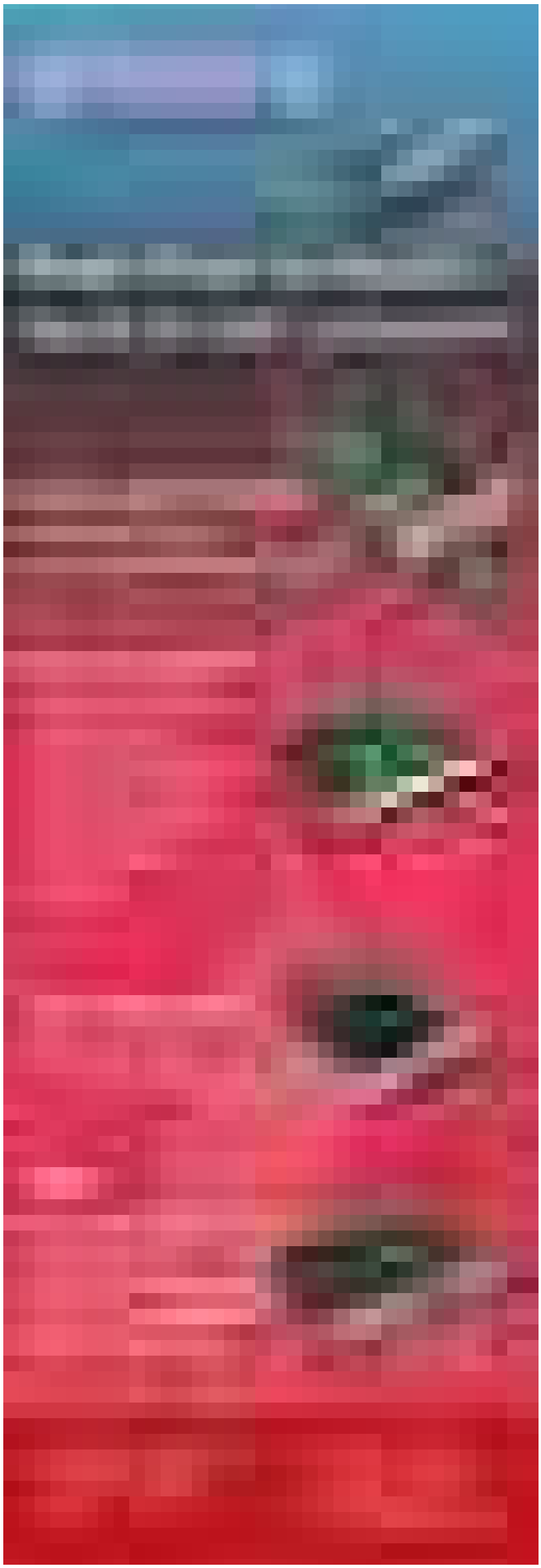


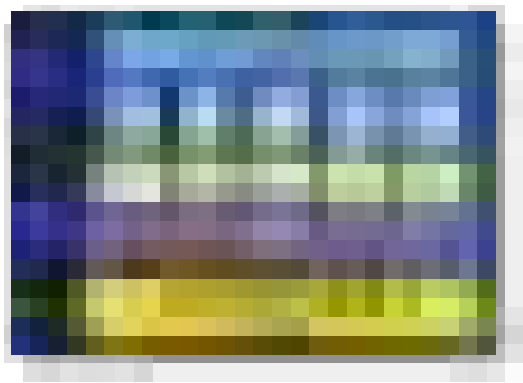
Smart I/O Module Controls 8 Solid State Relays

In automated or data acquisition-based military applications, solid-state relays are often where the electronics touch the real world. The I/O interfaces making that link continue to get more intelligent. An example is the Model 2652, a new member of Sensoray's 2600 series of smart I/O modules. This module monitors and controls any combination of up to eight standard solid-state relays (SSRs). It provides I/O services to a 2601 communication module, which in turn enables remote Ethernet clients to monitor and control the SSRs. The module's microcontroller communicates with the 2601 through an optically isolated serial interface. A single Category-5 UTP cable carries all microcontroller power and communication signals.

Sockets are provided for eight SSRs. Each SSR socket may be populated with any supported SSR type, including AC in, AC out, DC in and DC out. SSRs are secured to the module with integral hold-down screws. The 2652's microcontroller applies a 10 ms software debounce filter to all input SSRs. Input debouncing helps to minimize errors resulting from electromechanical switch bounce. Each output SSR may be explicitly controlled by the client, or it may operate as a PWM output with rate and duty cycle specified by the client. Single piece price for the 2652 is $213.

Sensoray, Tigard, OR. (503) 684-8005. [www.sensoray.com].





Tiny RTOS Supports Multi-Threaded MIPS Core

Multi-core processors are showing up on of all the major microprocessor vendor's roadmaps. And military system designers—particularly those after high compute density—need to be aware of the unique software issues that come with multi-core and multi-threaded CPUs. Addressing that trend, Express Logic announced the availability of its popular ThreadX RTOS for the MIPS32 34K multi-threaded (MT) processor core family. Through a cooperative development effort with MIPS Technologies, Express Logic has developed ThreadX/MT, an enhanced version of ThreadX for the MIPS 34K.

ThreadX/MT is based on Express Logic's popular ThreadX RTOS, a small, highly efficient embedded OS that minimizes system overhead and provides lightning-fast real-time response. With as small as a 6 Kbyte footprint and sub-microsecond interrupt response and context switch, ThreadX/MT perfectly complements the QoS mechanism in the 34K processor. ThreadX/MT introduces technology that automatically, or optionally, manually under program control, calculates 34K QoS weights for application threads to assure that the intended threads get the desired percentages of CPU cycles. ThreadX/MT for the MIPS 34K is available now from Express Logic, with royalty-free licenses starting at $12,500.

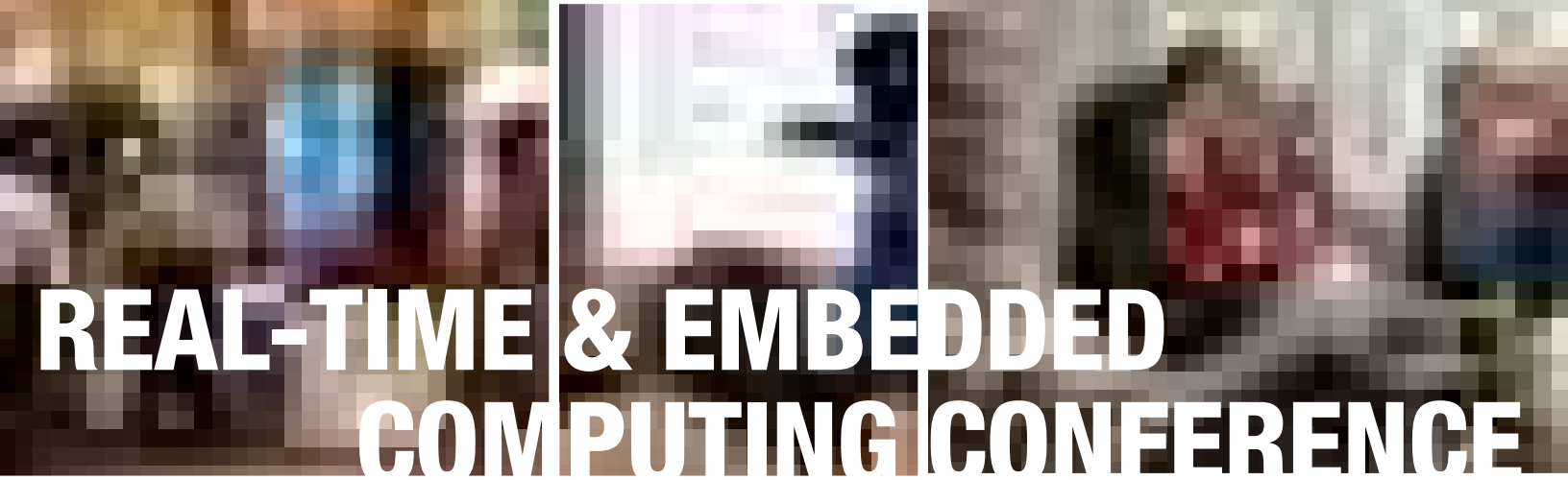
Express Logic, San Diego, CA. (858) 613-6640. [www.expresslogic.com].

IP Core Provides Serial RapidIO on Xilinx FPGAs

RapidIO ranks as one of the leading switched fabrics contending for mind-share among military embedded computer designers. Supporting the RapidIO ecosystem, Mercury Computer Systems has announced the availability of a new Mercury Serial RapidIO IP core for Xilinx Virtex high-performance and Spartan low-cost FPGA families. The new Serial RapidIO offering is a full-featured, high-function IP core that incorporates a logical layer, a transport layer and a physical layer, and supports input/output and message passing.

Compliant with the widely adopted Serial RapidIO specification 1.2, the Mercury IP core targets a wide range of applications for embedded, communications, wireless, storage and defense markets. Designers using Xilinx Virtex high-performance FPGAs can incorporate Mercury's IP to create devices with a robust Serial RapidIO endpoint for a variety of applications. Mercury's IP has been successfully integrated into multiple Xilinx components with either an internal or external SERDES device, and can also be used to create multi-port switches to aggregate other Serial RapidIO inputs. Xilinx high-performance MGTs (Multi-Gigabit Transceivers) offer core interface speeds of 4 x 3.125 Gbits/s, the highest available in the RapidIO standard.

Mercury Computer Systems, Chelmsford, MA. (978) 256-0052. [www.mc.com].



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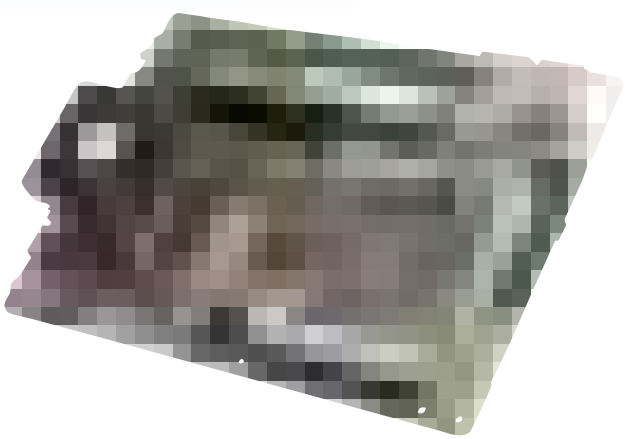

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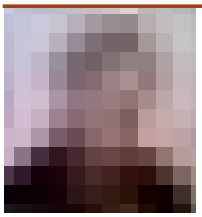
Coming Next Month

COTS JOURNAL

An enabling component for everything from advanced military radar systems to IED jammers, FPGAs rank as an indispensable technology for today's military system developers. We're proud that *COTS Journal*, together with our sister publication, *RTC* magazine, have over the years provided readers with more in-depth coverage of the system-level issues related to FPGAs and FPGA-based boards than any other publication. Continuing that tradition, the May issues of *COTS* and *RTC* will include a supplement called *FPGAs: The New Matix for Design*, for the combined 55,000+ readership of the two magazines to enjoy.

Here's what else we've got on deck for the May issue of *COTS Journal*:

- *Tailoring Processors for Military Apps*. Long gone are the days when military-specific microprocessors made economic sense. Now military system designers rely on embedded board vendors who have become masters at designing the latest and greatest workstation, laptop and server CPUs onto rugged single board computer solutions. Articles in this section examine the latest trends along those lines, as well as an update on firms that repackage processor die into modules in order to make solutions with better temperature grades or even radiation hardened.
- *Shock and Vibration for Boards & Enclosures*. It's no small feat to engineer boards and enclosures to meet the stringent levels of shock and vibration ratings required by most defense and aerospace programs. It's no longer sufficient to rely on outdated Mil-Spec guidelines like MIL-STD-810F. Full environment stress screening techniques like HASS and HALT are taking their place. Articles in this section delve into those and other techniques for mixing rapid thermal change with multi-axis, broad spectrum, random vibration.
- *FPDP and FPDP II Boards*. Sometimes simple ideas are the big winners. Such is the case with the Front Panel Data Port (FPDP) interconnect standard. Using an inexpensive ribbon cable, FPDP links boards without eating up more than a tiny amount of board space. It's particularly useful in military applications like radar and sonar where FPDP is used as the interface to sensor networks. Because it operates independently of the backplane bus, it provides a deterministic sustained bandwidth free from contention. This Tech Focus section updates readers on FPDP/FPDP II trends and provides a product album of representative board-level products.



Editorial

Jeff Child, Editor-in-Chief

If you read my Program Briefing section of *COTS Journal* last month, you're aware of some of the tricky challenges facing the DoD's Joint Tactical Radio System (JTRS) program. That program has been in reorganization mode for over a year now—with little public information surfacing during that time with any details of the reorg. In fact, as we go to press with this issue, the program's Web site, jtrs.army.mil, has reverted to a single page saying "a new JTRS public website is being developed by the JTRS JPEO." That said, recently details finally emerged revealing a new refocused vision for JTRS. Its new path—while less ambitious than the original vision—seems geared toward a scope that's easier to implement.

JTRS: Reloaded, Rescoped

First off, there's been some renaming of the various Clusters that make up JTRS. Henceforth the Army's portion of the JTRS program is to be known as "JTRS Ground Systems." Cluster 1 becomes "Ground Mobile Radio," while Cluster 5 will be known as "Handheld/Manpack/Small Form Fit (HMS) radios. Meanwhile, Cluster AMF separates into AMF Small Airborne (AMF-SA) and AMF Maritime (AMF-M).

Beyond those name changes, the biggest change in JTRS is a dramatic paring back in the number of waveforms to be included. In the initial ORD there were 32 waveforms—many of which were key to interoperability with legacy radios. The reorg—under ORD 3.2.1—reduces that list of waveforms down to six. They haven't ruled out doing all 32 at some point, but the goal now is to focus on six. The six include WNW, SRW, SINCGARS, EPLRS, MUOS and Link-16. What that suggests is a focus on empowering the networked battlespace—Soldier Radio Waveform (SRW) and Wideband Networking Waveform are the two networking waveforms. Meanwhile, only limited backward compatibility with old radios—SINCGARS and EPLRS waveforms—is included. MUOS and Link-16 are included for the airborne form-factors. Satellites supporting MUOS haven't been launched yet, but are expected to be in the next year or so.

These changes in scope for JTRS certainly make sense because the program clearly wasn't succeeding. If you read between the lines, however, it's clear that the issues I discussed in my March Program Briefing on JTRS—waveform portability and ITARS—are far from solved. In the early stages of the JTRS program a repository of waveforms was established, where anyone who needed a waveform because of a government contract, could go in and get it for free. To date there's nearly nothing available in the repository that developers can make use of. Companies just have no incentive to share their waveform Intellectual Property (IP) with one another. I even heard of one case where a company, when "compelled" to share their waveform code, handed over a completely unusable version of it. Can they be blamed for doing so when they were given no compensation for giving away their IP?

Along with the reorg of JTRS, a new rev of the DoD's Software Communications Architecture (SCA) will be released. The SCA is the core software architecture for JTRS. The new rev of SCA—likely to be called 2.2.2—reportedly still omits a critical piece to permit portability between FPGAs and DSPs. Instead that portability is addressed in what's named a JTRS HAL (Hardware Abstraction Layer). Unfortunately that JTRS HAL is—at least for now—under the ITARS (International Traffic in Arms Regulations) restrictions. Such restrictions will put a serious damper on development efforts, and any goal to get SCA any traction as a commercial standard goes out the window. Here commercial and international sort of go hand in hand. Any commercial electronics vendor with any influence is, almost by definition, a player in the international market.

While I'm sure there are many cases were ITARS restrictions are perfectly valid, this one instance seems downright silly to me. A hardware abstraction layer—essentially an API—is nothing more than a set of function calls. It's not like a sophisticated jet design or a complex algorithm that could jeopardize national security by sharing it. Apparently the JTRS JPEO feels the same way, and they are attempting to persuade the Department of State to lift the ITARS restriction on the JTRS HAL, but have not been successful to date.

In short, it's encouraging that the JTRS program has refocused to a project with fewer waveforms. That should help it move forward. That's good news for the many other DoD programs that depend and intersect with JTRS, like Future Combat Systems for example. But those pesky IP and ITARS issues plaguing the program still need to be addressed. ▮▮

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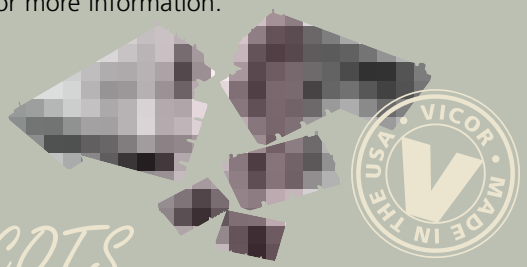

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